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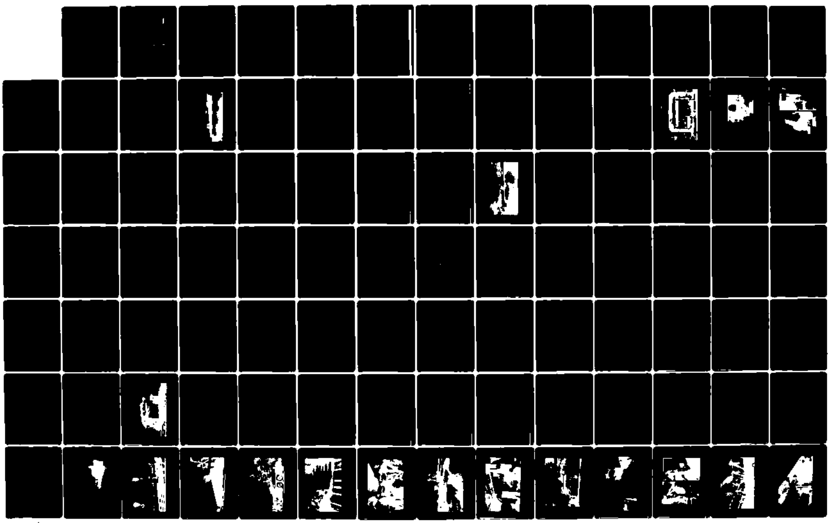

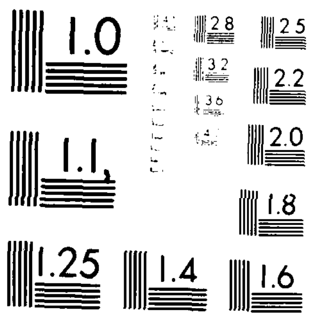

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LASH SHIP PRETEST RESULTS OF THE JOINT
LOGISTICS-OVER-THE-SHORE (LOTS) TEST
AND EVALUATION PROGRAM

7 MARCH 1977

Prepared under
Contract Number MDA-903-75-C-0016
For the Office of the Secretary of Defense,
Deputy Director (Test and Evaluation)
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Amphibious	Cargo	Embarkation
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Beach	Containerization	Floating Cargo Transfer Platform
Breakbulk	COTS	Joint Operation
Cantilever lift frame	Crane	Joint Test

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The major objective of the LASH ship pretest was to determine the ability of the Services to use a LASH bargeship for deploying selected heavy and outsized Logistics-Over-The-Shore (LOTS) equipment to a site where fixed port facilities do not exist. This test was the second of five planned preliminary tests in the Joint LOTS Operational Test and Evaluation Program being conducted under the sponsorship of the Deputy Director (Test and Evaluation), Office of the Director, Defense Research and Engineering (ODDR&E). The pre-

19. Key Words (continued)

LASH Ship	*Logistics-Over-The-Shore*	*Shipping*	Unloading
LCM8	LOTS	Stowage	
LCU	Mobilization	Terminal Service	
Lighterage	Pretest	Test and Evaluation	
Loading	Sealift	Transportation	

20. Abstract (continued)

test was conducted at the Naval Supply Center, Norfolk, Virginia, and at an anchorage off Ft. Story, Virginia, during August, 1976.

The pretest was the first time a LASH vessel was solely dedicated to a military exercise. As a result, besides providing a means to evaluate certain LOTS capabilities, the pretest provided the means to accomplish a number of major objectives including for the first time:

- Use of the LCM8 lift beam (a national defense feature developed by MARAD) to load and off-load any LASH ship,
- Use of the LCM8 lift beam on a C8 type LASH vessel,
- Military equipment deck-stowed on a LASH ship,
- Equipment other than barges off-loaded by the LASH barge crane into lighters in a seaway, and
- Military landing craft, LCM8 and LCU, employed in the discharge of cargo from a LASH ship.

Major LOTS equipment items selected for the pretest were a partially disassembled 140-ton capacity truck crane, the carrier of a disassembled 300-ton capacity truck crane, an LCM8, a container sideloader, a 4 x 10 causeway with 30-ton capacity crawler crane aboard, an LCM6 modified as a warping tug, and a 3 x 15 causeway section. The test load also included four LASH barges with military vehicles and palletized cargo.

A major revelation during the pretest was the failure of the Alliance barge crane on the LASH ITALIA to mate with the LCM8 lifting beam. The beam is a box girder attached athwartship on the barge crane and is necessary to adapt the ship for lifting cargo other than barges. A pierside modification was made to the gantry crane's gathering cones by trimming their inboard lips with a cutting torch. The need to make the alteration was due to a difference in LASH gantry cranes from the one involved in the original LCM8 lift beam test made in 1974 under MARAD sponsorship.

A major error was also found in the overhead clearance used for planning. The vertical distance between the LASH gantry crane and the deck hatch covers was determined to be 4 ft greater than planned. Verification of clearances will require actual measurement on each ship.

A major test event was the certification testing of a specially designed causeway lifting frame employing a cantilever principle. The lifting frame was attached to two LCM8 lift beams, modified for this test with the

20. Abstract (continued)

addition of new lifting points and padeyes. The lifting frame, developed to hoist equipment which have centers of gravities that can not be positioned under the ship's barge crane, failed to load a simulated 3 x 14 causeway warping tug but did load a 3 x 15 causeway section. The causeway lifting frame was certified by the American Bureau of Shipping for lifting 70 long tons. An analysis of the failure and the successful lift are set forth in this report.

There were two add-on features to the LASH pretest: the establishment of a floating cargo transfer platform about 800 yards off-shore, and use of a mobile Standard Port System (SPS) terminal on the beach. LASH barges were towed to the floating platform where cargo was transferred by an embarked 30-ton crane to LCM8s and LCUs for movement to the beach. At the beach cargo was documented and movement control was exercised using the mobile equipment. Moderately unfavorable weather conditions and the consequent sea state permitted some observations of their effects on operations of the floating cargo transfer platform.

In summary, all major test objectives were met. The test results verified capabilities for use of the ship to deploy equipment that cannot be loaded in LASH barges.

ABSTRACT

The major objective of the LASH ship pretest was to determine the ability of the Services to use a LASH bargeship for deploying selected heavy and outsized Logistics-Over-The-Shore (LOTS) equipment to a site where fixed port facilities do not exist. This test was the second of five planned preliminary tests in the Joint LOTS Operational Test and Evaluation Program being conducted under the sponsorship of the Deputy Director (Test and Evaluation), Office of the Director, Defense Research and Engineering (ODDR&E). The pretest was conducted at the Naval Supply Center, Norfolk, Virginia, and at an anchorage off Ft. Story, Virginia, during August, 1976.

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In summary, all major test objectives were met. The test results verified capabilities for use of the ship to deploy equipment that cannot be loaded in LASH barges.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

I. INTRODUCTION

BACKGROUND

The principal objective of the LASH Ship Pretest was to determine the ability of the Services to use a LASH bargeship to deploy selected heavy, outsized LOTS system equipment to and off-load at an operational site where fixed port facilities are not available.

The considerable lift capability of the LASH ship barge crane (approximately 500 short tons), the large clear area available for on-deck stowage, and spacious holds below make the LASH vessel especially attractive for deploying heavy, outsized equipment. (See Figure 1.) With 20 LASH vessels in service, the total lift potential in support of military operations is considerable.

Military experience with the LASH vessel has been limited to receiving military supplies and equipment by barges in ports and relatively sheltered waters. Experience in off-loading equipment from a LASH ship into small landing craft in a seaway was needed to confirm that these operations were, indeed, feasible and practical. Data were needed on actual times for loading cycles, moorings, and potential problem areas so that deployment requirements for LOTS equipment in the LOTS main test could be anticipated and accomplished smoothly and on schedule.

Basically two problems arise in the use of LASH ships for LOTS operations. First, not all equipment will fit in LASH barges; hence, they require special lifting gear for being hoisted using the LASH gantry crane. Secondly, shoreside facilities are required for unloading barges as they are not normally beached except in an extreme emergency. Thus, until adequate barge unloading facilities are available, LOTS equipment and accompanying supplies cannot be discharged from the LASH ship barges.

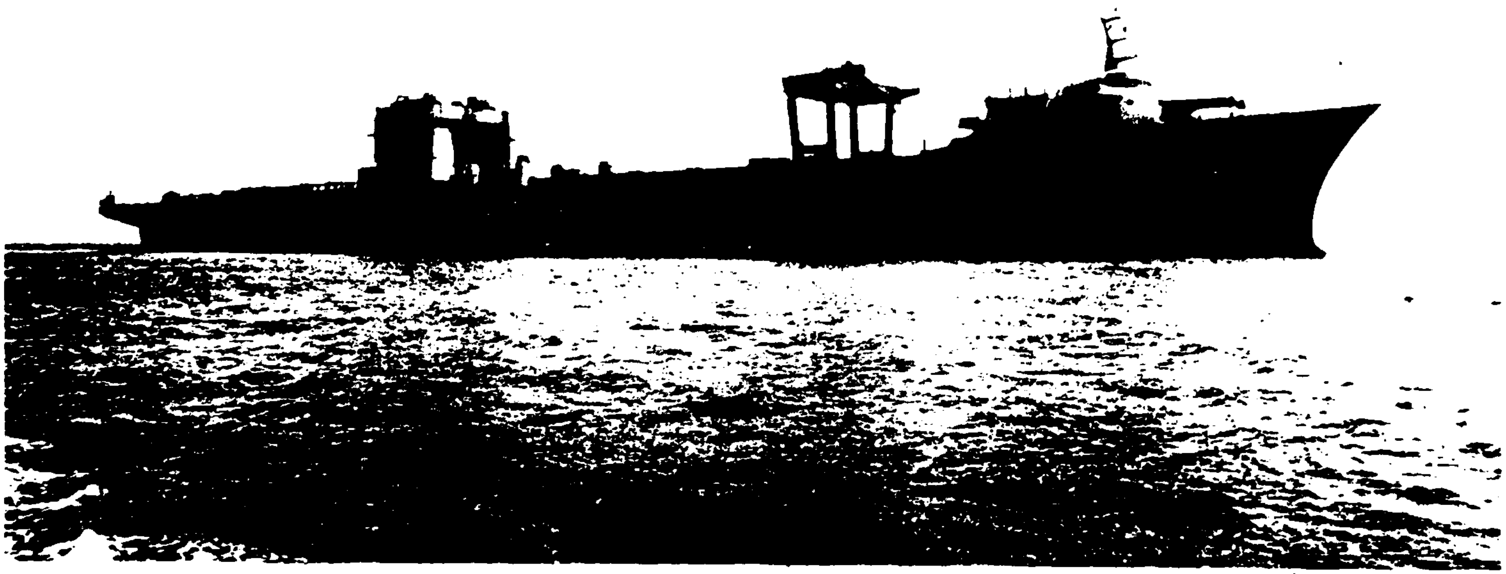

FIGURE 1. S.S. LASH ITALIA. The S.S. LASH ITALIA, a C881 Lighter-Aboard-Ship vessel, was chartered August 23-26, 1976, for the second in a series of LOTS pretests (the first pretest involved a conventional breakbulk ship). The LOTS pretest provided the Services the first opportunity to dedicate a LASH ship solely for military logistic operations and to operationally test the LCM8 lift beam.

For off-loading equipment separately from barges, a unique adaptive feature, the LCM8 lift beam (described below and in Appendix A), is required. This item, a national defense feature developed by MARAD, is placed athwartship so that it can be attached to the barge gantry crane. The LCM8 lift beam was certified for hoisting heavy loads (such as LCM8s) but was never operationally tested. The LCM8, for which the beam was designed, was never successfully stowed aboard the LASH vessel in the certification test— nor was any other type of military equipment. Accordingly, it was deemed prudent to test the deployment capabilities of a LASH ship in an operational environment prior to the main test scheduled the next year.

With regard to the second problem, the handling of LASH barge cargo, a pretest add-on included the deployment, assembly and operation of a floating cargo transfer platform. The latter operation was a Navy-supported exercise that had originally been scheduled as a part of Solid Shield 76 but postponed because a LASH ship was not available at that time (March 1976). Since barge unloading will be part of the LOTS main test, observations and analysis of that portion of the LASH pretest are included in this report.

Additional Service add-on test events included clearing cargo from the beach and demonstration of a mobile unit for documentation and management of cargo transiting the beach. These operations are also included in this report.

In summary, the pretest exercise consisted of the following operations:

- In-port loading by contract stevedores augmented by military personnel. (The latter were required for the assembly of certain special lifting frames and slings and the handling of the certain heavy and outsized items of LOTS equipment.)

- Movement of the vessel to an off-shore anchorage for discharge of test items by military stevedores with normal assistance by ship crew.

- Off-loading four LASH barges containing test cargo for movement to a Navy off-shore cargo transfer platform where the test cargo was transferred by crane to landing craft for continuation of movement to the beach.

- Beach clearance operations where the breakbulk cargo was transferred from landing craft at the water's edge to tractor-trailers.

- Establishment and operation of a remote terminal on the beach as a subelement of the Standard Port System to document cargo transiting the LOTS site.

Loading of the ship began [illegible] operations were terminated in the objective area [illegible]

TEST LIFTS

The test lifts selected for the [illegible] were [illegible] equipment items required for LOTS operations con[illegible] using the barge gantry crane. Equipment characteristics [illegible] Table 1. In addition, the items to be deployed had to be [illegible] moved to shore using only the type craft also embarked [illegible] For example, an LCM6 warping tug was included in the load in order to demonstrate its deployability and ability to move [illegible] causeway section (the latter carrying a 30-ton crawler crane) to an off-shore anchorage. An LCM8 was embarked to demonstrate its deployability and capability of lightering major crane components and a container sideloader ashore. [illegible], one of each type of equipment was loaded, although considerably more space was available for additional items. Since there was no prior experience with [illegible] of these lifts, the number of items loaded was held to that which it was estimated could be safely handled within the vessel charter time. The test load items and their characteristics are contained in Table 1.

For deployment the two truck cranes are disassembled to make them compatible with the limited stowage space or boom/crane lifting capacity of the ship. Minimum disassembly is referred to as "tactical" disassembly. In this configuration only about 8-10 hr are required to make each crane ready for operations. Maximum or "administrative" disassembly is required for deployment of the 300-ton capacity crane. The 300-ton crane was successfully disassembled, deployed, and reassembled in an earlier pretest.[1] About 20 hr were required for reassembly on the beach. In a "tactical" configuration the 140-ton capacity crane can be lifted by a 60-long ton ship's boom and lightered to shore in an LCM8. The 300-ton crane must be administratively disassembled in order for its largest components to be transported by an LCM8. Since the LCM8 is the largest landing craft that can be loaded on a LASH ship, this craft established crane disassembly requirements for this pretest.

Some items included in the LOTS Pretest Design[2] were deleted due to non-availability:

- A container frontloader, not yet delivered,
- A LACV-30, inoperable due to temporary mechanical difficulties, and

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[1] Operations Research, Inc., Report on Results of the Conventional Breakbulk Ship Pretest of the Joint Logistics-Over-The-Shore (LOTS) Test and Evaluation Program, ORI TR 1037, 29 October 1976.

[2] Operations Research, Inc., Design of Preliminary Field Tests for the Logistics-Over-The-Shore (LOTS) Test and Evaluation Program, ORI TR 993, 6 January 1976.

TABLE 1

LASH SHIP PRETEST PLANNED LOADS

Item	Length (Ft)	Width (Ft)	Height (Ft)	Weight (Long Tons)	Remarks
P&H 9125 Truck-Mounted Crane, 140-Ton Lifting Capacity (Tactical Disassembly)	52.7	11.25	13.1	53.6	Outriggers are extended approximately 12 in. further to attach sling lifting plate.
Carrier of P&H 6250 Truck-Mounted Crane, 300-Ton Lifting Capacity	47.5	12.0	8.0	53.6	Other components of crane were considered easier to load and, therefore, were not included in the test load.
Landing Craft, Mechanized (LCM8)	73.5	21.0	14.0	57.8	
Lancer 3500, Sideloader	41.5	12.5	11.7	65.9	
3 X 15 Causeway Section	92.0	21.5	5.25	67.3	A 7-ton weight (included here) was removed once the causeway was onboard.
3 X 15 Causeway Section with Weights (Simulated a 3 x 14 Causeway Warping Tug)	92.0	21.5	5.25	136.2	This lift was attempted and failed.
LCM6 Warping Tug	56.5	15.3	15.0	30.1	
4 X 10 Causeway with 30-Ton Crane	96.0	28.4	16.6	111.2	The length includes the length of the causeway with the crane's boom extended over the stern. Without it the causeway is approximately 60 ft long.
LASH Barges	61.5	31.2	12.0	80+	Four barges were loaded. Cargo weight is unknown.
LACV-30	76.0	32.5	21.5	24.2	A test sling was developed but a mechanical failure to the LACV-30 prevented it from being tested.
Frontloader	-	-	-	-	Vehicle characteristics are not available. Frontloader will be available about March, 1977.

- A 3 x 14 causeway warping tug. A 3 x 15 causeway section with weights was loaded to simulate the warping tug.

In preparation for the test a special sling and lifting and tie-down procedures were developed for the LACV-30. These are discussed in Appendix B. The attempted lift of the simulated 3 x 14 causeway warping tug is discussed in Appendix C.

TEST SHIP

The ship chartered for the test was the S.S. LASH ITALIA (C8-S-81b or C881 designation), the first LASH ship to be built in the United States. Its characteristics are contained in Table 2 along with those of two other types of LASH vessels in service.

TABLE 2

GENERAL CHARACTERISTICS OF LASH VESSELS

	C881	C981	
		Delta	Others
Length overall	820	894	894
Beam, molded	100	100	100
Draft, full load	35	35	35
Total deadweight tons, full load @ 35	30,020	40,592	46,152
Speed, knots	22.5	22	22
Number of Barge holds/hatches	4/8	6/14	7/17
Barge Capacity	50*	85	89
Number of container holds/hatches	2/6	1/3	0/0
Container capacity (dedicated slots)	534	288	0/0
Number of ships	11	3	6

* Except for five Prudential Lines ships, each with a container capacity of 322 and a barge capacity of 77.

There are 11 C881 type ships and nine C981 ships at the present time. These totals will change soon with four C881 ships being converted to non-self-sustaining containerships and four new C981s being built.

In total numbers LASH vessels constitute only about 6½ percent of the active U.S. dry cargo fleet, but in terms of total dry cargo deadweight capacity they represent about 13 percent of the fleet. A LASH ship can completely off-load in less than 24 hr and has a maximum speed of up to 23 knots. In terms of productivity (a function of tons per mile per year) on most trade routes these ships constitute better than 15 percent of total U.S. flag ocean-going capability. Militarily, a LASH ship's greatest potential is its capability to off-load barge cargo in an objective area with rudimentary shoreside cargo handling facilities. Also, its 500-short ton capacity barge gantry crane offers a significant capability for accommodating very heavy lifts and to some extent, outsized cargo.

Although a LASH ship had not previously been employed solely in support of military exercises, the Services had each conducted studies on various uses of the ship including the impact of LASH barges on amphibious and LOTS type operations. Barges loaded with test cargo had been unloaded off-shore in several experiments. As noted earlier, an LCM8 lift beam had been developed and certified for use. Also, the Navy had studied the feasibility of using a cantilever lift frame for loading equipment with centers of gravity that extend too far aft of the barge gantry crane for it to lift them without tipping. The joint LOTS LASH ship pretest was the first opportunity to validate the feasibility of using this ship with the LCM8 lift beam and the cantilever lift frame for loading and off-loading large, heavy items of equipment.

In order to use the LCM8 lift beam with or without the cantilever lift frame some modifications to the ship and the barge gantry crane's electrical circuitry are required. Appendix A describes all modifications in more detail. The modifications have been accomplished on the C981 LASH ships. The LASH ITALIA is a C881, which class of ships has not been modified. Since the LASH ITALIA was completing a regular overhaul, 4 days were added to the yard period and the work was completed just before presenting for out-loading operations in Norfolk, Virginia.

II. OPERATIONS

OPERATIONAL SUMMARY

Operations began 23 August, 1976, at a Naval Supply Center pier, Norfolk, Virginia. The LASH ITALIA was received just after a routine overhaul, during which time modifications to the limiting stops on the crane, adjustments to circuitry for the load frame (spreader), and new locations for the guides controlling the upward and downward movement of the load frame and barges had been made.

Almost immediately problems were encountered with the raising and lowering of the gantry load frame. The port and starboard mechanisms that control load frame movement could not be synchronized. As a result, the loading of the four LASH barges, normally a routine operation of from 1 to 1.5 hr, took all morning.

Once the barges were aboard, the next phase involved loading LOTS equipment. First, the LCM8 lift beam, without which none of the equipment could be loaded, had to be attached to the barge crane load frame. The attempt to mate the lift beam with the lift frame failed until a minor modification to the lift frame could be made. Details on this work are described below. Following on-site modification, two LCM8 lift beams were engaged and loading of LOTS equipment commenced. The test items scheduled to come off last at an anchorage off Ft. Story were the first to be loaded. The first item to be loaded was the simulated 3 x 14 causeway warping tug. This was a 3 x 15 causeway section with weights placed on it to represent the general weight distribution of a 3 x 14 warping tug.

To lift either a 3 x 15 causeway section or the lift simulating a 3 x 14 warping tug requires a special cantilever lifting frame attached to two LCM8 lift beams. Assembly of the causeway lifting frame was slow and not completed until 2120 that evening. At that time an unsuccessful attempt was made to lift the simulated warping tug. (For details see Appendix C.)

By 0830 hr the next morning, with most of the weights removed, the 3 x 15 causeway was loaded without difficulty. The lifting frame was then disassembled and stowed on top of the causeway. After that the remainder of the equipment, including an Army LCM8, was loaded without incident. Loading operations were terminated at approximately 1830 on the second day.

Early the third day the ship, which had moved during the night, was at anchor off Green Beach, Ft. Story. By 1400 all equipment was off-loaded except the 3 x 15 causeway. Attempts to assemble the causeway lifting frame were discontinued after 6 hr. As before, the principal difficulty was the tight fit of pins and padeyes connecting elements of the lift frame.

At 0650 on the fourth day another attempt was made to assemble the lifting frame and it succeeded. Approximately 1½ hr later the 3 x 15 causeway section was off-loaded. The causeway lifting frame and LCM8 lift beams were detached and the four LASH barges off-loaded before noon.

Operations then shifted to the floating cargo transfer platform where breakbulk cargo operations (barge to landing craft) were conducted. These operations had to be terminated in late afternoon of the 5th day, 27 August, when a crane failure occurred that could not be repaired on site. On the 6th day all equipment was retrograded to appropriate unit locations.

LCM8 LIFT BEAM

The Joint LOTS LASH Ship Pretest was the first operational use of the LCM8 lift beam since its fabrication and testing at the Avondale Shipyard, New Orelans, La. in November, 1974.[1] It was the first time that the LCM8 lift beam was ever used on an Alliance Manufacturing Co. LASH barge crane. The earlier test was conducted on a ship that used a slightly different type crane manufactured by the Morgan Engineering Co. A major difference in the two type cranes became apparent when the Alliance crane on the LASH ITALIA was unable to engage either of the two LCM8 lift beams due to a connection problem with the gathering cones. The gatherings cones are the points at which the load frame connects with the lifting points of the barge. Figure 2 shows the location of the gathering cones on the barge gantry crane and Figure 3 provides a close-up of one of the gathering cones.

An inside lip on each of the gathering cones (see Figures 4 and 5) prevented the cone from settling down far enough over the beam's lifting points for a horizontal locking bar to be engaged. The bar must pass through the load frame's gathering cone, through a hole in the LCM8 beam lifting point, and through the gathering cone on the other side in order to be fully engaged. As long as the lip prevented the proper seating, the locking mechanism was obstructed.

The only remedy that could be made on the spot was to trim about 2 inches from the inside lip on each gathering cone. This was accomplished as soon as the LASH ITALIA's master had received the concurrence of the ship's

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[1] See Civil Engineering Laboratory, NCBC, Port Hueneme, Ca., report entitled <u>LCM8 Lift Beam Tests— Outsize Lift Capability Added to the LASH System</u>, by D. A. Davis, dated February 1975, Report No. 55-75-05.

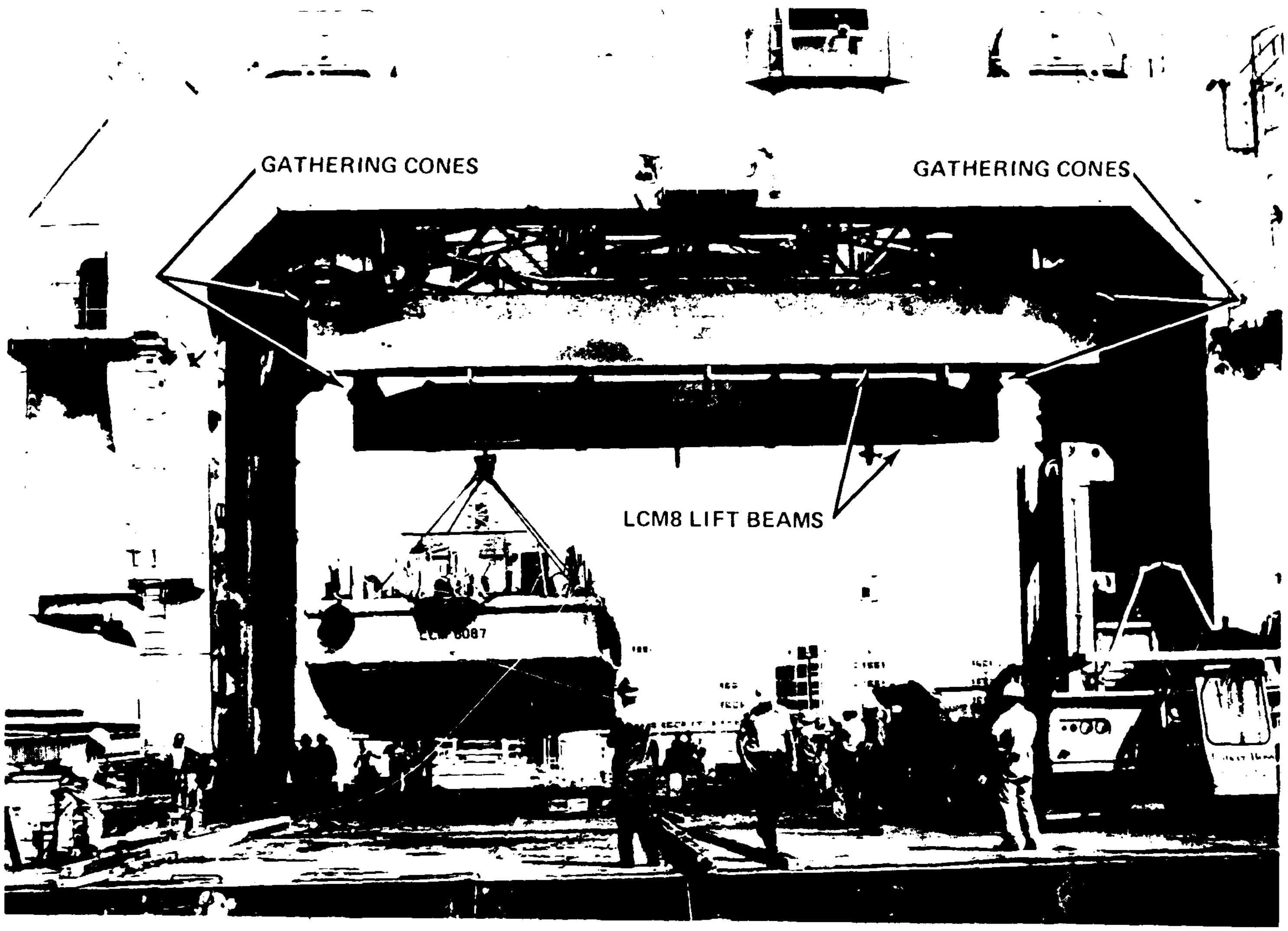


FIGURE 2. LASH SHIP BARGE GANTRY CRANE. Each of the four gathering cones required modification in order to engage the LCM8 lift beams.

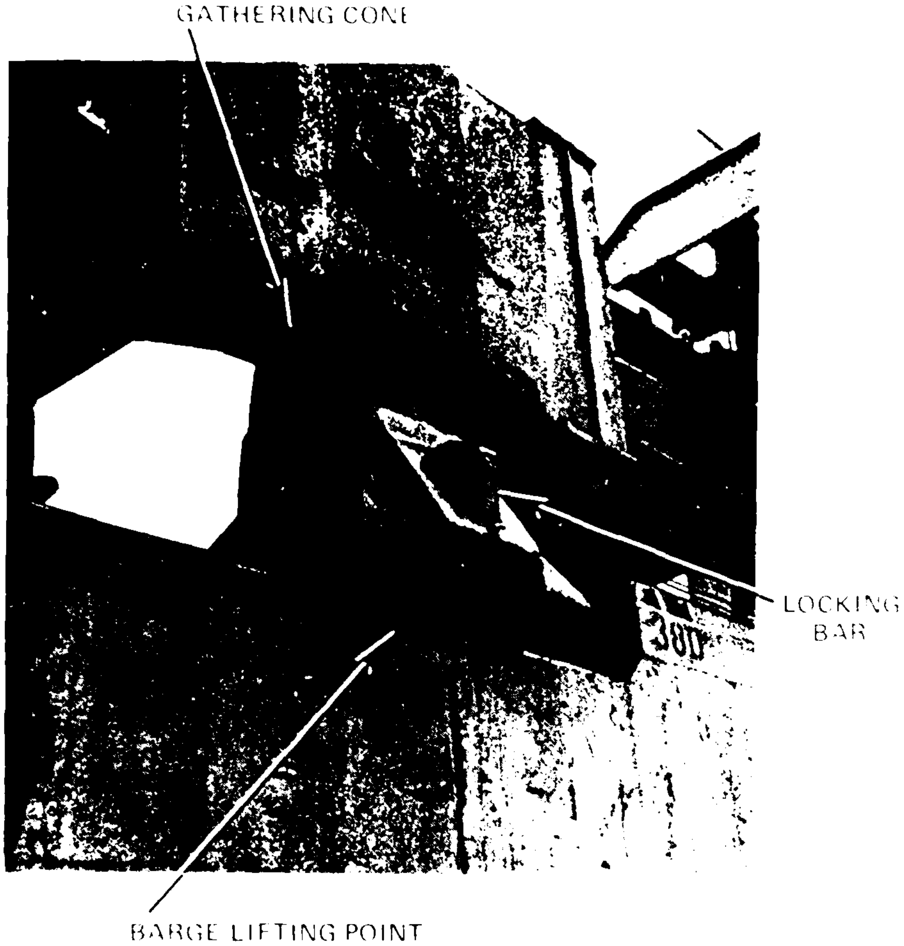
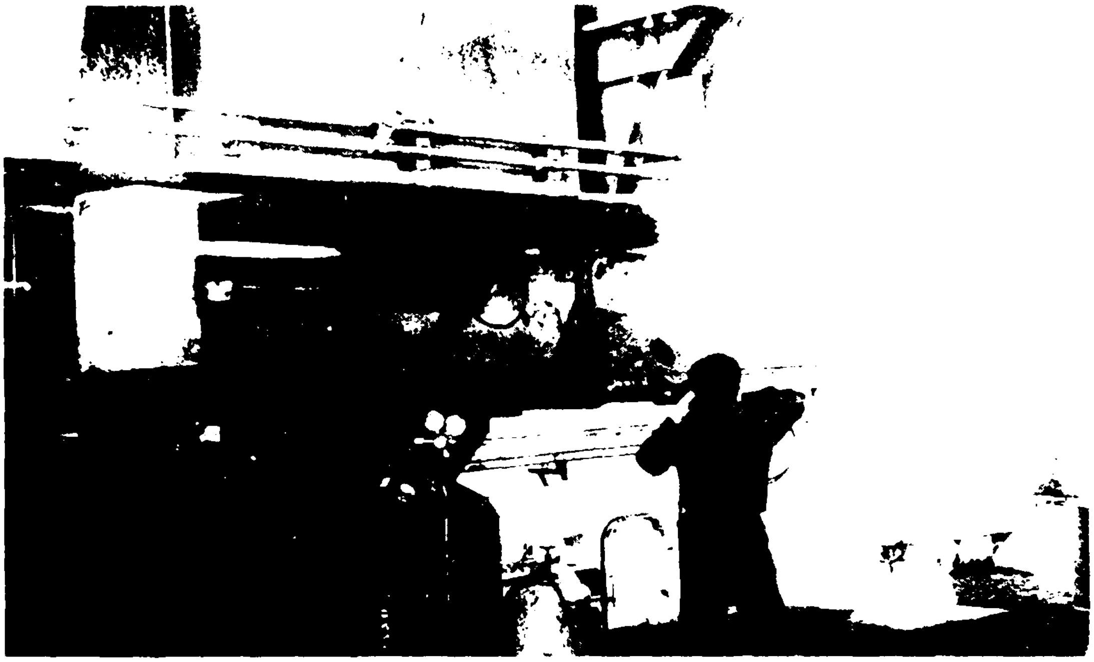


FIGURE [illegible]. GATHERING CONE ON EACH BARGE FRAME ENGAGES LIFTING POINT OF A BARGE



FIGURES 4 and 5. LCM8 LIFT BEAM IS ENGAGED. Following modification of the gathering cones with a cutting torch (above), the first LCM8 lift beam was engaged (lower photo) within 15 minutes, the second beam required 30 minutes. The requirement for modifying the lifting cones on an Alliance type crane (used on 14 of the 20 LASH vessels) was a major revelation from the LOTS pretest.

owners. The four inside lips were trimmed off (Figures 4 and 5) and approximately 45 minutes later both LCM8 lifting beams were engaged.

Appendix A describes the characteristics of the LCM8 lift beam, the prescribed modifications to the LASH ship to attach the lift beam, and the modifications made to the LCM8 lift beam in order to attach the causeway lifting frame.

LOADING

The loading of LOTS equipment went well except for the simulated 3 x 14 causeway warping tug, as noted above and discussed in Appendix C. This failure, along with the lengthy attachment and detachment of the causeway lifting frame (almost 4 hr) indicated that further developmental work by the Navy was required. Table 3 provides a summary of equipment and barge loading operations. To better understand the procedures used and the method in which data was collected, it is helpful to view crane cycles in their various components. Even though each item of equipment had to be handled somewhat differently— for example, the LCM8 had a different lifting point, rigging requirements, and a different sling from its predecessor the 140-ton crane— in terms of loading or unloading cycles certain basic steps had to be taken for each lift:

- The rigging (and sometimes a sling) on the lift beam for the last lift had to be removed and replaced with the necessary rigging (and perhaps a sling) for the next lift.

- The gantry crane with new rigging moved to the new pick-up point.

- A sling was attached to the LCM8 lifting beam rigging or LOTS equipment.

- The gantry crane picked up the new lift and moved it to the drop point.

- The sling was detached from either the vehicle or the lift beam.

- The gantry crane moved to the rigging point to be readied for the next lift.

With these steps in mind the data on ship loading and off-loading listed in the two tables which follow were tabulated in segments of time defined as follows:

- Gantry Crane Motion Time. Those periods of time in which the crane was either lifting or lowering a test item or was in the process of moving fore or aft with a load or moving (once the lift beam had been fully rigged) to a position in order to lift a test item.

TABLE 3

LASH SHIP LOADING TIMES
(In minutes)

Cargo	Time Load Staged*	Time Event Commenced	Total Time Gantry Crane in Motion	Attach/ Detach Load From Crane	Adjust/Change Rigging	Avoidable Delays	Unavoid-able Delays	Total Cycle Time
Load LASH Barge 386	0732	1030	34.2	–	N/A	–	(178)**	34.2
Load LASH Barge 144	1039	1104	24.4	–	N/A	–	–	24.4
Load LASH Barge 397	1116	1127	25.5	–	N/A	–	2	27.1
Load LASH Barge 070 (Incomplete Cycle)	1140	1154	9.5	–	N/A	–	–	9.5
Install LCM8 Lift Beams								
Install Guides, Load Beams	–	1300	–	–	–	–	90.0	90.0
Modify Ship	–	1430	–	–	–	–	150.0	150.0
Install First Beam	1324	1700	–	–	15.0	–	–	15.0
Install Second Beam	1431	1715	–	–	30.0	–	–	30.0
Install Causeway Lift Frame (Rigging)	1755	1755	10	–	145.0	–	60.0	215.0
Loading Attempt of 3 x 15 Simulated Warping tug (not completed)	2130	2140	5.0	15.0/3.0	(above)	15.0	–	38.0
Load 3 x 15 Causeway	0745	0748	40.0	2.0/4.0	–	–	–	46.0
Detach Causeway Lift Frame (Rigging)	0834	0834	2.0	–	77.0	–	3.0	82.0
Attach Crane Strongback (Rigging)	0830	0956	2.5	–	26.0	–	–	28.5
Load 140-Ton Crane	1016	1025	13.5	12.0/4.0	10.0	–	–	39.5
LCM8 Test Load	–	–	5.5	–	–	–	–	5.5
LCU Test Load	–	–	5.2	–	–	–	15.0	20.2
Load 300-Ton Crane Carrier	1125	1131	20.0	19.0/20.0	5.0	–	6.0	78.0
Load Sideloader	1242	1249	14.5	9.0/6.7	51.0	2.0	–	83.2
LCM8 Test Load	–	–	3.5↓/2.0↑	–	–	–	1.0	6.5
Load LCM8	1438	1420	20.5	20.0/35.0	76.0	–	4.0	151.5
Load 4 x 10 Causeway	1543	1615	27.0	2.0/2.0	20.0	–	–	51.0
Load LCM6 Warping Tug	Unknown	1742	24.0	2.0/2.0	8.0	–	–	36.0

* Staging time provided for information only, it is not included in calculations for cycle time.
** LASH barge gantry crane was deadlined just prior to the first lift. However, for general information this down-time is parenthetically included even though not part of the loading cycle.

- Time to Prepare Lift Beam. Time required to rig the LCM8 lift beam with chains, shackles, pins, a crane strongback, or causeway lift frame, and the time to remove same in order that a lift may be conducted or terminated.

- Time for Attachment or Detachment. The time required to attach a load to the lift beam once the fully rigged beam has been positioned directly over the load; or the time required to detach a load from the lift beam once the load has come to rest and the sling legs have been slackened.

- Unavoidable Delays. Necessary periods of time such as lunch breaks, crane casualties, or any interruption in the loading/off-loading cycle that could not be foreseen or avoided.

- Avoidable Delays. Delays that, given proper forethought, need not have occurred. Simple mistakes made by operating personnel were considered part of the normal course of an operation and were generally included in the category deemed appropriate.

The columns separated by heavy black borders in the loading and off-loading tables are provided for information only and were not included as part of the calculated crane cycle times. They represent staging activities accomplished concurrently with the crane activities. Had a delay occurred either because a load was not staged in time for lifting or had a load not been cleared from the LASH's well during the ship discharge phase these times would have created delays and would have been significant to the tabulations.

Clearances

Clearances between equipment and LASH ship structures were of the greatest concern in load planning. Not all ships of a given class are ever exactly alike and this becomes important where clearances in inches count. According to one report,[2] the minimum overhead clearance for a LASH ship with an Alliance type crane is 29 ft 3½ in. This overall height less 5 ft 2½ in. for the LCM8 lift beam, leaves 24 ft 1 in. as the figure to be used in load planning. No figure was given for minimum clearance following the Avondale Shipyard LCM8 lift beam test.[3] Since that test failed in its attempt to load an LCM8 by a few inches, the concerns for clearance appeared to be well-founded. During the planning for the LASH ship pretest there were still some confusing differences and serious gaps in information concerning clearances.

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[2] J. J. Henry Co., Inc., LASH Amphibious Port-Assault Support (LAPS) Mission, Phase I – Conceptual Design Analysis, Task No. FD75, sponsored by Naval Facilities Engineering Command, dated 1 March 1976, pgs. 4-17, 4-19.

[3] op. cit.

First, a C9-1 type LASH ship, the S.S. GREEN HARBOUR, equipped with a Morgan type crane was used in the Avondale Shipyard test. In that test when the load frame was raised to the maximum height, the keel of the LCM[illegible] lacked approximately 2 inches of clearing the LASH stern rail. However, at that point there was about 3 ft of horizontal clearance between the stern of the LCM8 and the transom of the ship. It was, therefore, assumed that the test would have been successful if a different shackle arrangement had been available. No further tests were ever made to prove or disprove this assumption and the required shackles were never procured for the three lift beams on hand.

There was another major difference between the shipyard test and the proposed pretest which further complicated the understanding of test results and pretest planning with regard to vertical clearance. The LCM8 used was an aluminum hull type with a different center of gravity and lifting characteristics from the steel one to be used in the pretest. The LCM8 fore and aft sling pad-eyes were closer together on the aluminum model than the steel model. Since it was not recorded whether the sling used in the lifting test was a special one or a normal sling, the Army slings were shortened 12 inches to be on the safe side in the LOTS test.

After the LOTS pretest, a follow-up check was made and it was reported that the clearance from the load frame to the center of the hatch square was 34 ft 3½ in. With an allowance for the LCM8 lift beam of 5 ft 2½ in., there was ample clearance for loading the LCM8.

Horizontal clearances were also of importance. It was assumed that (following modification of the LASH ship's barge crane so that it could travel farther aft) the horizontal distance from the centerline of the LCM8 lift beam to the stern of the ship would be about 32 ft. This distance did not get measured during the test, but it was subsequently calculated to be 33 ft 7½ in.

Equipment Handling

During the loading phase no problems were experienced with the lifting and stowage of equipment other than the failure to load the simulated 3 x 14 causeway warping tug. An analysis of this failure is contained in the next section of this report.

A special sling and strongback that could be adapted for lifting either the [illegible]-ton or 300-ton crane by simply changing the connecting points on the strongback was used for the first time.

Hoisting the Army's new container sideloader was another first in the LASH ship pretest. To accomplish this lift, the spreader was removed from the sideloader. Then the sideloader's mast was shackled to the LCM8 lift beam and lifted aboard ship.

The LCM8 was one of the most questionable lifts in terms of vertical and horizontal clearances. No particular difficulties were encountered with the lift other than a substitution of shackles for some missing ones required to attach the sling to the lift beam. The lift was made with approximately

3½ to 4 ft of vertical clearance over the hatch and approximately 1 ft of horizontal clearance between the transom of the ship and the stern of the LCM8. The only lift which had less clearance was the 3 x 15 causeway which had approximately 2½ ft at its lowest end (the causeway had a slight forward tilt when hoisted). The 4 x 10 causeway, which had a 30-ton crane lashed on it, is one-third shorter than a 3 x 15 section. It was loaded without requiring the cantilever lift frame and had no center of gravity problem. The lift did require the use of both LCM8 lift beams.

The lightest and fastest lift embarked was an LCM6 warping tug weighing approximately 34 short tons and requiring 36 minutes. The slowest and second heaviest lift was the LCM8. The total time of 2½ hr included about 1½ hr to change rigging on the LCM8 lift beam, plus nearly another hour to attach and detach the sling and to place dunnage on the deck.

OFF-LOADING

Off-loading began 25 August, 1976, with the LASH ITALIA anchored approximately 3,500 yards off Green Beach, Ft. Story. Initially the sea was calm (see Table 4) with minimal winds. The first loads off were the LCM6 warping tug and the 4 x 10 causeway, both of which were dispatched to mooring points off Green Beach. The Army LOTS equipment stowed on deck was not slated for landing at Ft. Story and was dispatched on lighters to Ft. Eustis as planned. The barges were off-loaded last and towed to the off-shore transfer point off Green Beach.

TABLE 4

SEA STATE DATA*
LOTS LASH PRETEST

	Average		Average Upper One-Third		Extreme	
	Peak	Trough	Peak	Trough	Peak	Trough
Time 1115, 25 August 1976, Ft. Story, Virginia						
Wave (feet)	0.76	-0.73	0.99	-0.93	1.41	-1.15
Roll (degrees)	1.15	-1.12	1.63	-1.74	2.54	-2.44
Pitch (degrees)	0.50	-0.57	0.77	-0.88	[illegible]	-1.29
Heave (feet)	0.41	-0.40	0.58	-0.55	0.71	-0.68
Time 0800, 26 August 1976, Ft. Story, Virginia						
Wave (feet)	0.99	-0.98	1.62	-1.59	3.59	-2.65
Roll (degrees)	1.32	-1.34	2.07	-2.12	3.65	-3.82
Pitch (degrees)	0.66	-0.82	1.09	-1.40	2.14	-2.70
Heave (feet)	0.62	-0.65	0.97	-0.98	1.56	-1.60

* Wave and heave data are given in feet and roll and pitch data are given in degrees.

With the exception of the assembly of the causeway lifting frame noted earlier, off-loading operations were conducted with dispatch. Table 5 provides a compilation of the time and events. The fastest equipment item to be discharged was the carrier for the 300-ton crane. The LCM6 warping tug might have been faster but had to be delayed until a full crew of military stevedores could board the ship. Exclusive of the 3 x 15 causeway the slowest item to be discharged was the LCM8. Again, rigging times accounted for most of the time. Still the $1\frac{1}{2}$ hr total cycle time for discharge of the LCM8 nearly halved the $2\frac{1}{2}$ hr required to load it.

The 3 x 15 causeway section was the slowest item to be unloaded because of the excessive time to assemble and disassemble the lifting frame. Approximately 4 hr was spent the first day trying to attach the frame to the ship before securing on account of darkness. The difficulties with the weighty struts and close tolerances for pins through padeyes were as experienced during the loading operations in port. On the second day, 26 August, a different approach was tried. The procedures were reversed, that is, to attach the heavy struts to the lift beams first and then to the causeway. The revised procedured proved successful. The second attempt required only about 1 hr for the assembly. To remove the causeway lifting frame from the LCM8 lift beams required slightly more than an hour.

One of the easiest operations was the detachment of the LCM8 lift beams from the gantry crane load frame. The beams were lowered onto dunnage stacked on deck, detached, and the load frame was ready for barge operations in only 11 minutes.

Barges

The last phase of ship unloading was the discharge of four LASH barges loaded with military cargo. The gantry crane removed the hatch cover in 13 minutes and began discharging barges. The cycles were, respectively, $14\frac{1}{2}$, $17\frac{1}{2}$, $18\frac{1}{2}$, and $20\frac{1}{2}$ minutes. The times recorded for the barges from the time they were in the water to the time they had been secured by tugs and cleared the well were $6\frac{1}{2}$, $5\frac{1}{4}$, 3 and 3 minutes, respectively. Two LCM6 warping tugs/tender boats were used on each of the first two barges and only one on each of the last two. No problems or difficulties were encountered by the LCM6 craft in the relatively calm sea during the unloading phase.

FLOATING CARGO TRANSFER PLATFORM

General

Without pier facilities there are relatively few options for unloading cargo from barges. Beaching a barge might be one such method, but because of the deep barge draft and the shallow slope of typical beaches, this can require a very large crane to attain the reach and lifting capacity necessary. The option preferred has been the off-shore floating cargo transfer platform described below. The concept is not new but its application with respect to discharging barges is.

TABLE 5

LASH SHIP OFF-LOADING TIMES
(In minutes)

Cargo	Time Event Commenced	Attach/Detach Load From Crane	Total Time Gantry Crane in Motion	Adjust/Change Rigging	Avoidable Delays	Unavoidable Delays	Total Cycle Time	Time Load Clears Well
Off-Load LCM6 Warping Tug	0653	3.0*/4.0	18.0	Unknown	4.0	44.0	[illegible]	[illegible]
Off-Load 4 x 10 Causeway	0806	4.0/2.0	28.0	9.0	–	–	43.0	[illegible]
Off-Load LCM8	0849	4.8/8.5	28.0	36.0	–	4.8	76.0	0953
Off-Load 6250 Carrier	1005	17.5/2.5	24.0	2.3	–	–	46.3	1045
Off-Load 140-Ton Crane	1051	13.6/1.0	24.0	6.4	7.0	1.0	52.0	[illegible]
Off-Load Sideloader	1144	3.0/1.5	15.5	41.7	–	–	62.1	[illegible]
(LUNCH	1245 - 1345)	–	–	–	–	60.0	60.0	–
Off-Load Handling Gear	1345	–	–	–	–	–	15.0	1356
Install Causeway Lift Frame (Rigging)	1401 - 1840	Unsuccessful	Attempt Halted	238.0	–	–	238.0	–
	0630	–	–	57.0	–	15.0	72.0	–
Off-Load 3 x 15 Causeway	0742	1.6/4.2	19.5	9.1	4.0	10.3	48.7	[illegible]
Detach Causeway Frame	0832	–	3.0	67.0	–	–	70.0	–
Detach LCM8 Lift Beam	0942	–	–	11.0	–	–	11.0	–
Detach Guides	0953	12.0/3.0	1.5	43.0	–	–	59.5	–
Remove Hatch Cover	1057	3.0/3.3	7.0	–	–	–	13.3	–
Off-Load Barge 070	1110	–	14.5	–	–	–	14.5	1122
Off-Load Barge 397	1125	–	17.5	–	–	–	17.5	1145
Off-Load Barge 144	1143	–	18.5	–	–	–	18.5	1210
Off-Load Barge 386	1202	–	20.6	–	–	–	20.6	1216

* LCM6 had already been hoisted before full deck crew had boarded. This time represents the additional time required to add taglines.

Description

The floating cargo transfer platform consisted of three causeway sections and a Navy P&H model 640 crawler crane (30-ton capacity) lashed down on the center section. An aerial view of the transfer platform is shown in Figure 6. The three causeway sections were connected end to end. The two end causeways were 3 x 15 cube sections, while the center section with crane on board was a 4 x 10 cube section. Camels (telephone poles banded together with cables) were attached to both sides of the center causeway as fenders for LASH barges and lighters.

Other floating cargo transfer platform equipment included: two 4,000-lb capacity forklifts to work the interior areas of the barges not accessible to the crane's cargo hook; a floodlight unit for night operations; warping tugs/tender boats to tow and position barges; crane maintenance and support material for refueling, greasing, changing rigging, minor repairs, etc.; and a portable sanitation facility.

Operations

Although a few Army stevedores worked on the floating cargo transfer platform, its operation was primarily a Navy function. Both Army and Navy lighters were used to ferry cargo to Red Beach. Army units participated in the shoreside phase by off-loading the landing craft and by checking, processing, documenting, and clearing cargo from the beach. The accounting and movement control functions were accomplished utilizing a mobile data processing element.

Operations on the floating cargo transfer platform commenced with the off-loading of the first LASH barge at 1230 on 26 August. Operations proceeded around-the-clock until terminated at 1740 on 27 August when a crane failure occurred that could not be repaired at sea. Cause for the failure, a cracked outer retaining ring and four sheared roller center pin nuts, could not be identified. The plan was for all four LASH barges to be off-loaded at the transfer point. At the time of the crane casualty 121 of the 143 pallets in the third barge had been transferred. When it was evident that off-loading could not continue, all four barges were towed back into port. Because the floating cargo transfer platform was an adjunct to the LASH ship test, no arrangements had been made for instrumentation to record wave activity. A detailed description of barge unloading preparation and cargo handling is contained in Appendix D. Figure 7 shows the distribution of lift times recorded during the pretest.

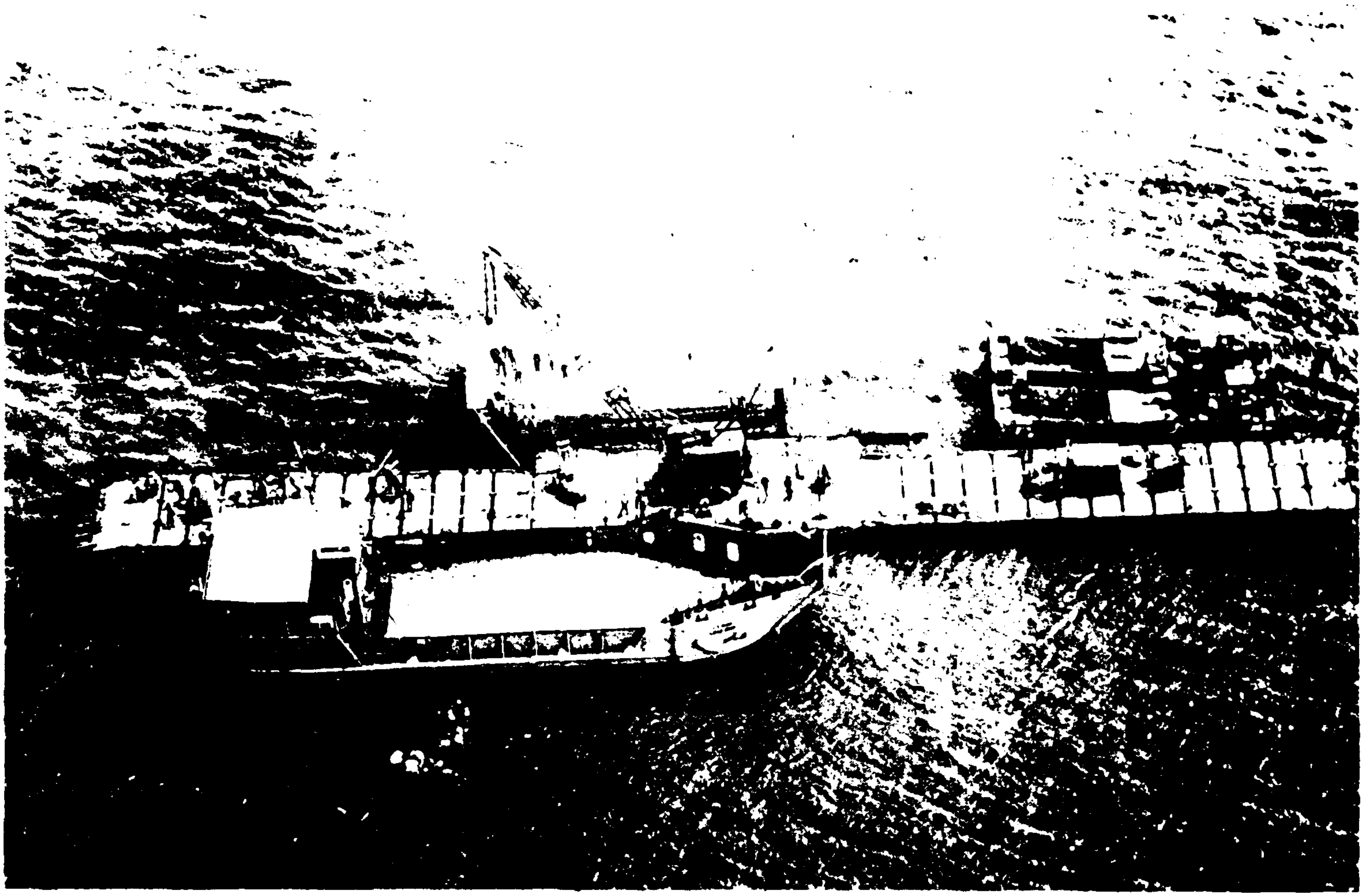


FIGURE 6. FLOATING CARGO TRANSFER PLATFORM. A floating cargo transfer platform was moored to a buoy approximately 800 yards off Green Beach. The platform was used in unloading cargo into landing craft from the LASH barges, which could not be beached. The platform basically consisted of a 4 x 15 causeway section with a 30-ton crane mounted on it and two 3 x 15 causeway sections, one attached to each end.

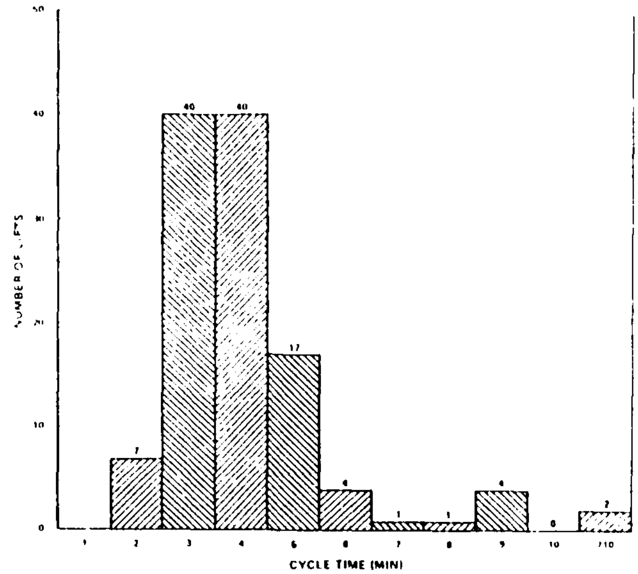


FIGURE 7. DISTRIBUTION OF LIFT TIMES FOR FLOATING CARGO TRANSFER PLATFORM

Weather

The major drawback to operations on a floating cargo transfer platform is its vulnerability to adverse sea conditions. It was observed during the LOTS pretest that as sea state three conditions were approached, the operation slowed considerably and became hazardous for embarked personnel. Because there was no instrumented record of sea state conditions at this location and because numerous broken pallets also adversely affected off-loading time, very little operation-environmental correlation is possible.

One point of concern during the period of rough seas was the danger of hook pendulation. With a load attached to the block, taglines were employed to dampen pendulation. Once the load was detached, no taglines were used and the hook swung freely. Pendulation control was improved by substituting a smaller block for the one originally on the crane. The smaller block, 250-lb verses 1,000-lb, is recommended by the Navy for future floating platform operations.

BEACH OPERATIONS

Cargo began arriving at Red Beach about mid-afternoon on 26 August. The first craft, an LCU, arrived approximately an hour before low tide. After 45 minutes attempting to beach, the LCU proceeded to a floating causeway operated by a unit on a separate training exercise. The LCU was given permission to marry up with the causeway and unload its cargo of military vehicles. During the 2 days of beach operations, 10 landing craft were dispatched to Red

beach. The other nine were able to land but approach-to-off-load times varied considerably according to tidal conditions. An evaluation of the situation is made in the Analysis Section of this report.

Once a lighter had landed, rough terrain forklifts unloaded the craft and moved the cargo to a beach marshalling site. Here the cargo was tallied and movement control exercised from there. At the beach clearance site the cargo sometimes had to be repacked before it could be shipped to "consignees." Table 6 gives the average beach handling time for each type of cargo moved.

TABLE 6

LIGHTER-TO-BEACH AVERAGE CARGO HANDLING TIMES

Item	Average Time
Vehicles	2.0 minutes
Concertina (per roll)	2.7 minutes
Pallets	2.2 minutes
Mixed cargo (pallets and rolls of concertina)	2.4 minutes

ARMY STANDARD PORT SYSTEM (SPS)

General

Cargo movement across Red Beach was recorded and monitored by an Army documentation team using, for the first time, a mobile van housing ADP equipment. Like the floating cargo transfer platform, use of the mobile unit was also an add-on to the LOTS LASH ship pretest. An improved mobile SPS capability will be used in the LOTS main test in 1977.

The purpose of the mobile SPS terminal is to provide timely documentation for the movement of cargo, to maintain inventories and an audit trail of intransit cargo, and to provide a capability for locating cargo in response to inquiries. In essence, the DA SPS is an operating system as opposed to a management information system. It is designed to respond within a constrained time frame to provide required documentation for the receipt, discharge, and onward movement of cargo. The mobile unit provides a capability of establishing a data link to DA SPS being supported at a logistics base.

During the LASH pretest the mobile SPS performed limited water terminal cargo data processing operations. Major pretest objectives were to:

- Establish automated procedures to eliminate repetitive manual preparation and transmission of cargo/container receipt and lift data in over-the-shore (LOTS) operations.

- Improve methods of reporting the movement of cargo and containers to include decreasing the time lag between events and reporting changes in cargo/container status.

- Provide terminal, movement control, and carrier management and operating personnel with an interim automated system which may be enhanced or replaced in the future with electromagnetic or electronic scanning devices with a minimum of turbulance.

- Determine communications requirements for transmitting and receiving data between the beach and the servicing DA SPS computer at a support base.

Red Beach Operations

The mobile SPS terminal on Red Beach was mounted in a converted Army air conditioned refrigerator van. The equipment consisted of a 1K Memory Unit (PDP-16), a card reader, printer, filing cabinets, and desks (see Figure [illegible]). The van was moved by truck from Ft. Eustis to Ft. Story. At the beach site the van was positioned by a sideloader. No damage or any operational problems resulted from the movement of the equipment.

The normal transmission of the advance copy of the manifest from the port of debarkation was not played during this pretest. "Canned" manifest data was used instead. As cargo was off-loaded from lighters and transferred to trucks at Red Beach, documentation personnel completed discharge tallies and passed them to the ADP van. Since the mobile SPS terminal did not have a keypunch machine, a courier took the tallies to the Ft. Story communications center for processing. Then the cards were returned to the card reader and printer in the mobile van where a print out was made of the cargo off-loaded at Red Beach. (See Figure 9.) Also, there was no radio or telephone line between the van and the communications center at Ft. Story. Courier service had to provide this communication link. The communications center transmitted the TCMD data to the DA SPS computer, a Univac 70/15, at Ft. Eustis, where all required reports were printed for distribution.

FIGURE 8. ADP MOBILE VAN

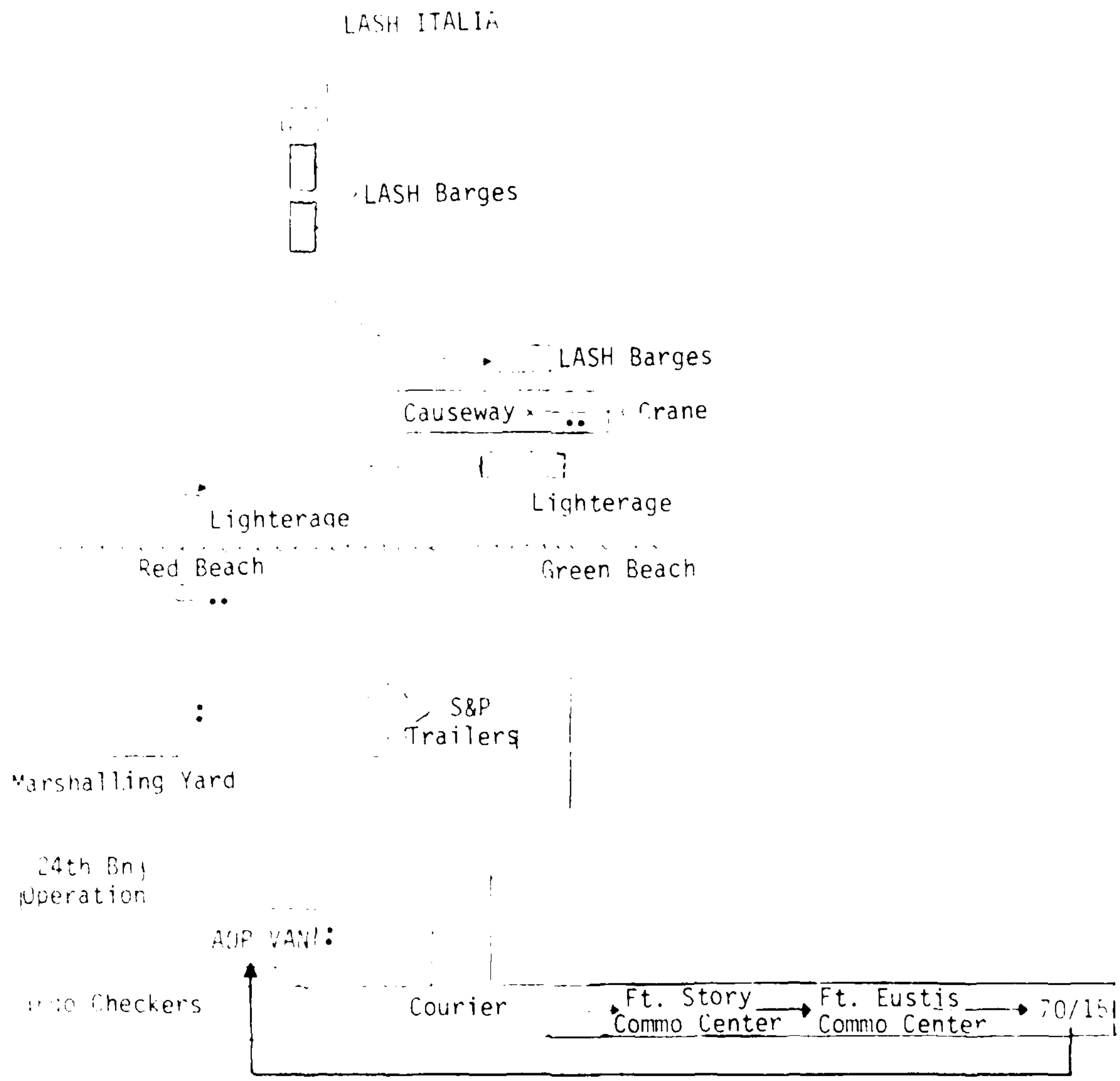


FIGURE 9. CARGO AND DOCUMENTATION FLOW

III. ANALYSIS

GENERAL

The results of the LASH ship pretest indicate that the ship can be used for deploying heavy, outsized LOTS equipment in the main test or in an actual contingency operation. Without the experience gained from the pretest, extensive operational delays and possibly critical load/off-load failures could have resulted. A considerable amount of time and effort was spent by test planners in anticipating and resolving difficulties and questions in the following areas:

- Requirements for special slings, strongbacks, and other lifting devices,
- Adequacy of clearances between lifts and ship structure,
- Operating military landing craft as lighters with a new type of commercial ship, and
- Estimating the timing and scheduling of loading and discharging operations.

These were not areas requiring research and developmental efforts, but rather were the kinds of problems that operational personnel would have to deal with in an innovative way in a contingency situation. Prior to this pretest there had been no experience with LASH vessels in military operations upon which to base planning or to examine the adequacy of organizational equipment and standard operating procedures. The type of loading situations that needed resolution by military operational personnel required problem analysis and preparation of special rigging (large shackles, cables, pins and padeyes) of a size and strength not readily available. The LASH ship pretest focused attention on the detailed procedures and equipment needed to accomplish the

deployment of the most difficult LOTS equipments. There was sufficient lead time for the procurement of most special rigging items, although not all arrived in time or were necessarily the correct ones. The test plans also made provision for sufficient time to check out alternative procedures and to ensure that the test equipment selected for loading could be safely handled.

Since this was the first time a LASH vessel was ever dedicated to a military exercise, there were several major findings with implications for future plans and operations. These findings, discussed subsequently in greater depth, are:

- The LCM8 lift beam does not mate with Alliance type LASH barge cranes unless crane gathering cones are modified,

- The vertical clearance from padeyes on the LCM8 lift beam to the cargo hatch covers was found to be greater than indicated in previously available information,

- Off-loading from the ship into military landing craft (LCM8 or LCU) can be accomplished in a seaway, and

- In handling equipment separately from barges, considerable gantry crane productivity is lost due to rigging requirements.

LCM8 LIFT BEAM

The LCM8 lift beam at the present time is a prerequisite with the barge crane for loading or unloading cargo not being transported in barges. No equivalent adaptive device is available in commercial trade. At the present time, in a contingency situation all LASH ships would have to rely upon the availability of only three LCM8 lift beams located in Norfolk, Va., a location somewhat remote for ships operating in the Gulf Coast and from the West Coast. In support of East Coast LOTS type organizations all three LCM8 lift beams may not be enough. For West Coast units with a LOTS-type mission, specifically Navy and Marine Corps units, the present distribution of LCM8 lift beams is totally inadequate. Although West Coast units do not yet have access to a causeway lifting frame, with two LCM8 lifting beams a counterweighting scheme could be employed to accommodate loading 3 x 15 causeway sections. As an alternative 4 x 10 sections can be loaded with the LCM8 beam. If West Coast military organizations are to use the LASH ship for deployment of equipment which cannot be loaded in LASH barges, provision for the emergency repositioning of available LCM8 lift beams should be planned. Otherwise, consideration should be given to the fabrication of additional LCM8 lift beams.

Currently, there is no developed concept for employment of the LCM8 lift beam despite its critical importance to the capabilities just described. Several questions would seem pertinent regarding its intended employment. On this matter, the Services should provide some guidance as to mission requirements:

- What military equipment requires an LCM8 lift beam for loading/discharge and where are these items located?

- What units and equipment should have priority use of the LCM8 lift beams?

- How many and at what locations should LCM8 lift beams be positioned?

- Should the LCM8 lift beam be off-loaded in the objective area for future discharge or redeployment of large equipment; if so, how is it to be off-loaded and how does the next LASH ship load it?

Future LCM8 Lift Beam Design Improvements

Because clearance between outsized equipment and LASH ship structures is so critical (discussed below), a design change should be considered in any new LCM8 lift beam construction to facilitate operations. The attachment points do not have to be below the lift beam. For example, since the lift beam is hollow except for spaced, internal structural members, a redesigned beam could take advantage of this space by raising the attachment points to higher locations. Fabrication costs would be increased but the added clearance (approximately 2 ft) could be very critical, especially on ships with Morgan cranes which, if available clearance measurements are correct, only have 23 ft 9 in. clearance after the LCM8 lift beam is installed.

CLEARANCES

Clearances, obviously, will vary from ship-to-ship. However, in the case of the LASH ship the overhead clearance is a critical limit for the deployment of LOTS equipment, particularly the LCM8 and the LACV-30. Until this pretest a few inches were thought to be the difference between a "go" or "no go" in loading the larger items. For the LASH ship pretest the Army had a special LCM8 sling, constructed with each leg 12 inches shorter than those of a standard LCM8 sling. This fabrication proved to be unnecessary since the LCM8 had about 4 ft of clearance over the hatch square.

At present, it is not known if the LASH ITALIA has a higher clearance than the other 19 LASH ships. This may be the case with the six C9 class ships equipped with Morgan type cranes but should not be generally assumed for the remainder with Alliance cranes. In any case, there is no certainty that the published clearances are correct. In view of the value of these vessels for deployment of military equipment and the probable infrequent use in future exercises, the Military Sealift Command should take the initiative to verify the actual clearance on each ship.

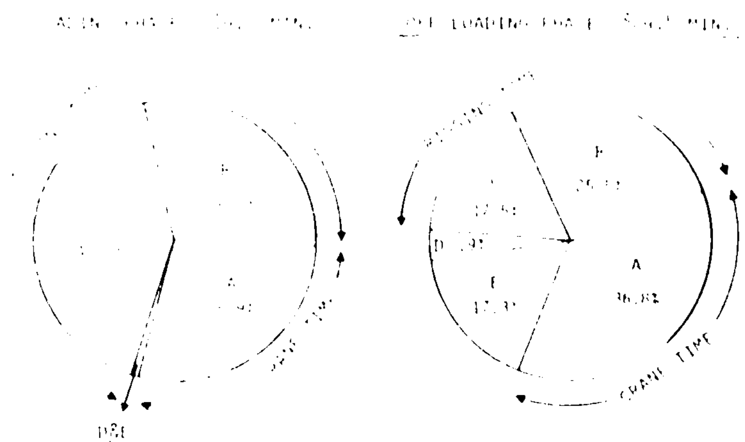
In determining the clearance the measurement should specify whether the figure extends from the gathering cones to the hatch cover itself or the barge pedestals located on top of each hatch cover. This distinction is necessary because the pedestals will not interfere with loads passing along the centerline of the ship.

EQUIPMENT ANALYSIS

Each item of equipment deployed presented different handling problems and was selected for the pretest for that reason. As a result very little grouping was possible in data analysis. Due to total lack of data on LASH ship operations of this type, ORI personnel made detailed timings of loading and unloading crane cycles. These data are included in Tables [illegible] and [illegible] and summarized in Table 7.

The most revealing aspect of this data is the distribution of time by activity. Figure 10 illustrates the division of time for loading and off-loading the LCM8 and all vehicular cargo. During loading, the ship's barge crane was idle approximately [illegible] percent of the time while some aspect of rigging was taking place. During off-loading, rigging time required approximately 43 percent of the total time. Since the speed at which the barge crane can operate has an upper limit, further reduction in equipment loading and off-loading time would require improvements in rigging gear and procedures. Rigging during outloading took longer than the discharge period because the stevedores had become more familiar with the rigging problems and were more proficient the second time.

As a rough guide, based on the available data, a ratio of 3:1 should be allowed for rigging heavy, outsized lifts versus the time the barge crane would be in motion. During loading the crane motion time averaged 17.5 minutes per item except for the [illegible] x 15 causeway which was not included in these averages. During off-loading, a ratio of about 1.5:1 would be appropriate considering better familiarity with the rigging and the fact that a slightly slower crane motion rate of [illegible]3 minutes per lift was experienced due to load pendulation.



KEY

- A — GANTRY CRANE IN MOTION
- B — PREPARE/REMOVE RIGGING ON LIFT BEAM
- ATTACH/DETACH LOAD TO LIFT BEAM
- D — AVOIDABLE DELAYS
- E — UNAVOIDABLE DELAYS

FIGURE 10. DIVISION OF TIME FOR LOADING AND OFF-LOADING OF LCM8 AND VEHICULAR CARGO

TABLE 7

LASH PRETEST SUMMARIES

Type Cargo	Total Time Gantry Crane In Motion	Attach/Detach Load From Frame	Adjust/Change Rigging	Avoidable Delays	Unavoidable Delays	Number of Cycles	Total Cycle Time
LOADING SUMMARY[1]							
Barges	93.2	–	NA	–	2.0	4	95.2
Causeway (3 x 15)	40.0	15.0/5.0	202.0	15.0	63.0	1	340.0
Other Equipment	149.0	66.0/71.7	216.0	2.0	10.0	6	514.7
(Install LCM8 Lift Beams)	–	–	45.0	–	240.0	–	285.0
TOTALS	282.2	81.0/76.6	463.0	17.0	315.0	11	1234.9
OFF-LOADING SUMMARY[2]							
Barges	71.1	–	–	–	13.3	4	84.4
Causeway (3 x 15)	19.5	1.6/4.2	371.1	4.0	25.3	1	431.7
Other Equipment	137.9	45.9/19.5	95.4	11.0	49.8	6	374.5
(Detach LCM8 Lift Beams)	16.5	–	54.0	–	–	–	70.5
TOTALS	245.0	47.5/23.7	520.5	15.0	88.4	11	961.1

[1] Excludes test loading replications into landing craft. Includes lift attempt of simulated warping tug.

[2] Two different approaches were used to attach the causeway lifting frame to the gantry crane's lifting frame. The times required for both attempts (238 minutes for the first and 72 minutes for the second) are included.

One area within the rigging category where immediate improvement in loading and unloading times appears possible is in attachment/detachment times, shown as Section C of the pie charts in Figure 10. All of the Army equipment had slings in which pins and shackles were required. Pins can become bound in shackles. They require a cotter pin to hold them in place which may be lost. Although the pin and shackle arrangement is the safest, it is also the slowest. Chains with hooks are much easier and faster to use. For example, in attaching the causeway to the causeway lifting frame, it was necessary to attach 12 chains to various lifting points. This was done using chain hooks with spring-held latches to keep the hooks from slipping off. A four-man crew attached all 12 chains and cleared the causeway in less than 2 minutes. By contrast, a four-man crew using a sling with pins and shackles required 9 minutes to attach only two shackles to the sideloader; yet, this was the fastest time a load was readied using shackles. If chains and hooks had been used instead of pins and shackles on all of the Army LOTS equipment, it is estimated that total rigging time could have been reduced by as much as an hour during loading and 30 minutes during off-loading.

As a safety consideration the time to secure or detach equipment while using the lift beam can be critical during loading or unloading at an off-shore anchorage. The clearance between the top of most equipment and the bottom of the LCM8 lift beam was on the order of only 3 ft. This clearance can be quickly reduced to zero as the load rises with a swell. The sudden contact could severely damage equipment or injure personnel. Thus, the less time spent attaching or detaching rigging under such conditions the better. In one instance during this exercise the spot lights on top of the 140-ton crane were damaged during off-loading because of inadequate clearance and an inability of the crew to rapidly detach the load. Fortunately, the damage was minor.

Mooring in a Seaway

Lighter mooring at the stern of the LASH ship for equipment loading was not difficult in the calm seas. None of the LCUs nor LCM8s experienced problems. Although not all moorings were timed, the samples taken (two LCM8s and two LCUs) appear to be representative. The LCM8s each required approximately 3 minutes. The LCUs required 8 minutes for a stern-to-stern marriage and 6½ minutes for a bow-to-stern marriage.

CAUSEWAY LIFTING FRAME

Analysis of the Failure

The causeway lifting frame was designed to lift items of equipment which have a center of gravity that cannot be placed under the crane's load frame; that is, any equipment when rigged for lift which has a center of gravity located more than 32 ft aft of the ship's transom. Such equipment cannot be loaded because its center of gravity tries to swing to a point directly below the suspension point but is prevented from doing so by butting against the ship.

There are two basic ways to avoid this. One is to move the effective center of gravity; the other way is to move the suspension point. A way to move the center of gravity is to counterweight the item so that the new center of gravity of the combined item and the counterweight is less than 32 ft from an end. This procedure is feasible for some lifts (see Appendix B for lifting the LACV-30) but there may be some drawbacks. The causeway lifting frame, which moves the suspension point further aft of the ship, was devised as an alternative. The lifting frame increases the horizontal clearance making it greater than 32 ft. The permissible center of gravity location for the item being lifted is thereby moved further aft in a so-called cantilever effect.

In considering the foregoing, note that the causeway lifting frame is suspended too. In effect, the entire assembly is a see-saw pivoted under the after LCM8 lift beam. The lifted item pulls downward from a point aft of the see-saw fulcrum and is balanced by a force pushing downward forward of the fulcrum (see Figure 11). Note that whatever balancing force is needed must be furnished by one or more compression struts of the lifting frame up to a force limit. That limit is the combined weight of:

- The compression struts,
- The forward LCM8 lift beam, and
- That portion of the LASH gantry gear above the forward LCM8 lift beam that is supported by the forward hoisting cables (i.e., half of the weight of the articulated gantry load frame with its hardware).

If this limit is exceeded, it seems clear that the forward end of the causeway lift frame will rise and the gantry articulated load frame will correspondingly tilt upward. The capability to tilt (i.e., to "articulate") is designed into the load frame to accommodate for the roll and pitch of a LASH barge in a seaway. It is now clear that a combination of forces and tilting motion occurred during the unsuccessful attempt to lift the simulated warping tug.[1] For further reference to the see-saw analogy the lightweight youngster on the long arm of the see-saw could not properly balance the heavyweight using the shorter lever arm. The successful lift of the 3 x 15 causeway that followed involved a lesser weight which was within the balancing weight limit of the causeway lift frame assembly.

The causeway lifting frame so far has been the only method used to load causeways. One alternative suggested has been to counterweight the causeway sections. This could be accomplished by placing a 25-ton weight on the end of the causeway nearest the ship transom. Alternatively, a somewhat heavier counterweight could be suspended from the forward LCM8 lift beam so that as the causeway's forward end started to lift and rotate up it would be immediately

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[1] In a post-mortem discussion with a Navy representative involved with the lift frame project, the basic difficulty was said to be an error made in the placement of the weights on the causeway deck, resulting in a different-from-intended position of the center of gravity.

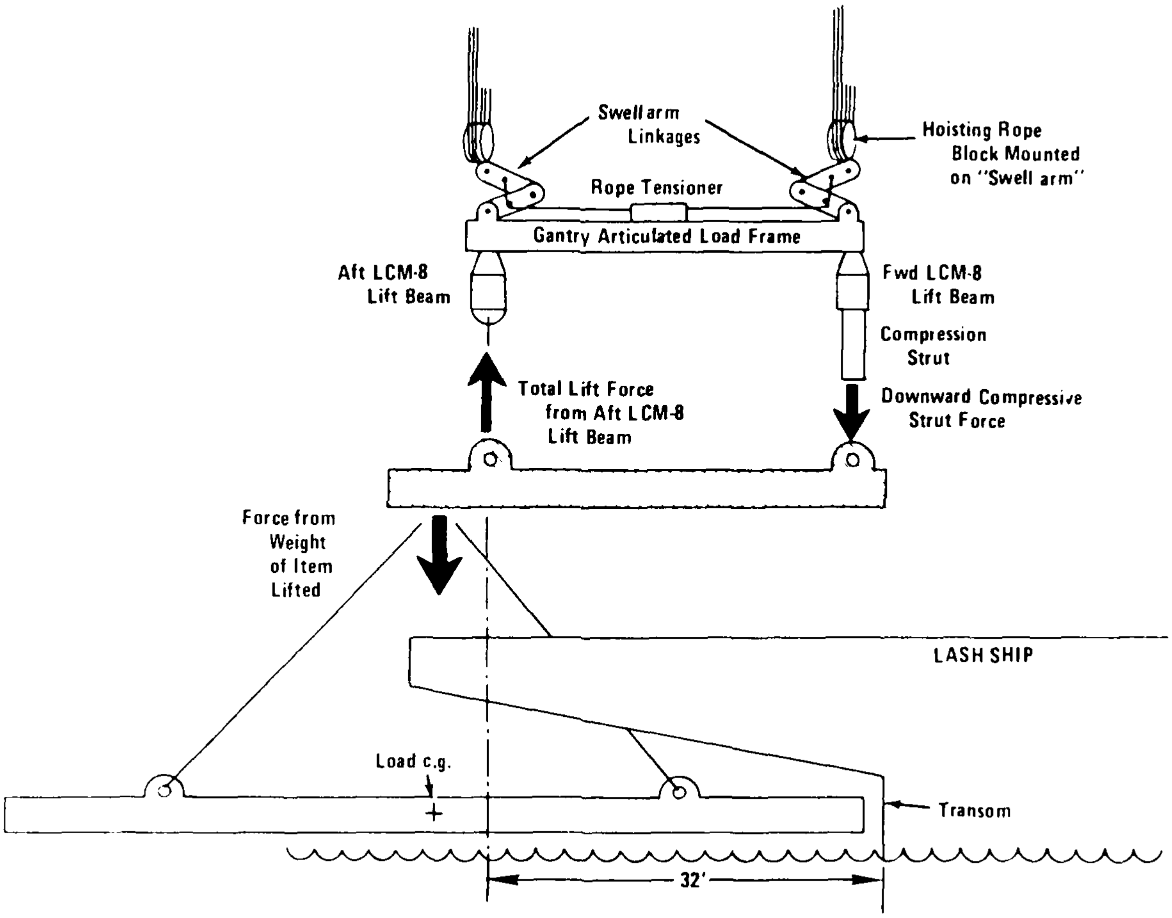


FIGURE 11. SCHEMATIC DRAWING SHOWING FORCES ACTING ON THE CAUSEWAY LIFT FRAME
(Shaded area is the causeway lift frame.)

met and prevented from further rotation by the counterweight suspended from the lift beam. As the lift progressed, both causeway and counterweight would rise together and the causeway would remain level.

The advantage of such counterweighting would be that it would eliminate a considerable amount of assembly and disassembly time required by the causeway lifting frame. It would also save a considerable amount of stowage space atop the causeway sections that otherwise could be used for equipment stowage. Only one counterweight would be needed for all lifts. Unlike the causeway lifting frame, which has a major drawback in that stowage on deck is primarily limited to the center, three different positions across the ship for a load are available using the present LCM8 lift beam padeyes, and more weather deck stowage locations are possible for some loads if rigging is planned ahead of time. Of course, there are beam limitations on such lifts. Only two 12-ft wide causeway sections could be loaded side by side using present padeyes.

Employment

Assembly of the causeway lifting frame during the test was not an easy or speedy operation. According to personnel responsible for the causeway lifting frame project, some of the deficiencies could be remedied by increasing the size of holes for pins and by substituting chains for struts on the aftermost lift beam. No estimate can be made on the time that could be saved with this modification since it has not yet been attempted.

BARGE LOADING AND UNLOADING

Barge loading took longer than had been anticipated due to a casualty to the crane's electrical system. The manual override system was much slower than the normal system. Figures 12 and 13 show the times recorded at each sequence of the loading cycle. The flatter the curve, the faster the cycle time. In normal operations the average barge cycle time is said to be about 15 minutes. Only one barge approximated this time during the off-loading phase and it was 30 seconds faster. All other times were slower, depending upon how far down into the hold the lifting frame had to be lowered to attach a barge. Attachment and detachment times for barges were so fast that they were not recorded. Only one hatch cover removal was timed. There were no delays and the operation required about 13 minutes.

Moving barges clear of the well of the ship did not pose any problems for the LCM6 craft used. Getting the barges to the mooring point took considerably longer than clearing, particularly as wind and sea conditions worsened. It is apparent that the closer to the mooring point the LASH can discharge its barges, the fewer tender/warping tugs will be needed due to faster turnaround times. It is conceivable that a ship's off-loading could be delayed because barges could not be cleared from the stern fast enough. In this regard, commercial type tugboats like the Army's, may be better suited for LASH barge operations than Navy LCM6 craft since they are more powerful and can handle more barges per trip. However, they require a safe haven or base for storm protection and maintenance support. The Navy 3 x 14 causeway warping tug has been proven effective in this role but these craft at this time are very limited in number.

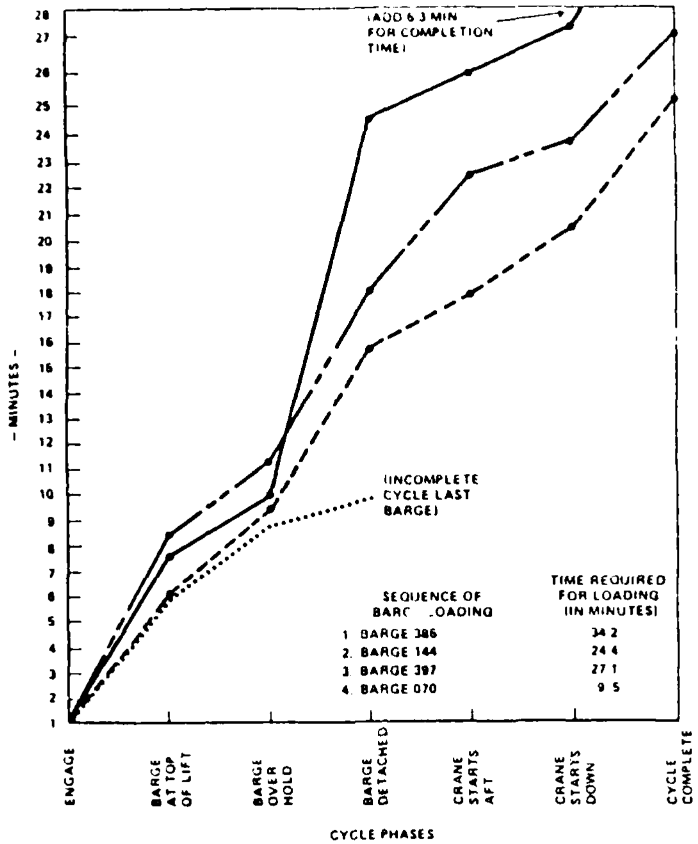


FIGURE 12. BARGE CYCLE TIMES DURING LOADING

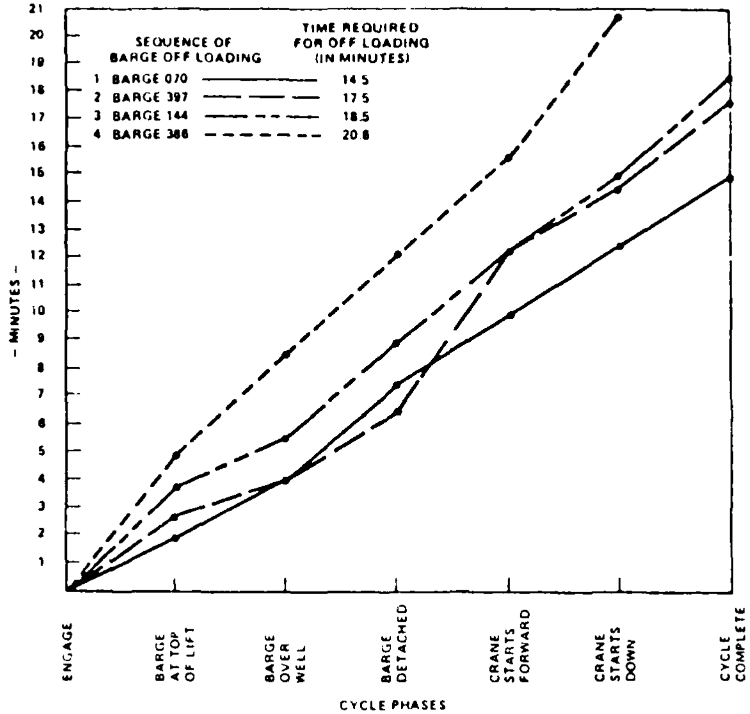


FIGURE 13. BARGE CYCLE TIMES DURING OFF-LOADING

FLOATING CARGO TRANSFER POINT

In a LOTS environment a floating cargo transfer platform is one method for unloading cargo from a barge (LASH or SEABEE). However, as was noted during the pretest, this mode of operations is vulnerable to weather conditions and in even a moderate sea state a floating cargo transfer point is probably the most dangerous aspect of a LOTS operation.

During the unloading period swells from 3-4 ft were encountered. In this sea state the principal problems noted were:

- Considerable difficulty was experienced in handling the rather large barge hatch covers,
- Landing craft mooring lines parted,
- The crane's block swung so dangerously that tagline handlers were required even when there was no load on the hook, and
- Barges and lighters surged against the platform when the seas were running at an angle to the centerline of the platform.

Operations at the floating cargo transfer platform were terminated on the second day by a crane failure. The exact cause for the failure to the outer retaining ring and roller center pin nuts may be attributed to several things. However, the instability of the small transfer platform and the resultant structural stresses experienced by the crane should be investigated as strong potential causes. If this is the case, then a larger crane and/or a more stable platform may be required.

At best, this type of operation should be considered an interim measure until more potentially productive and safer facilities, such as an elevated causeway or jacked-up DeLong, can be installed. Compared to the elevated causeway and jacked-up DeLong, operations at the floating cargo transfer point appeared to be more fatiguing and required double handling of all cargo.

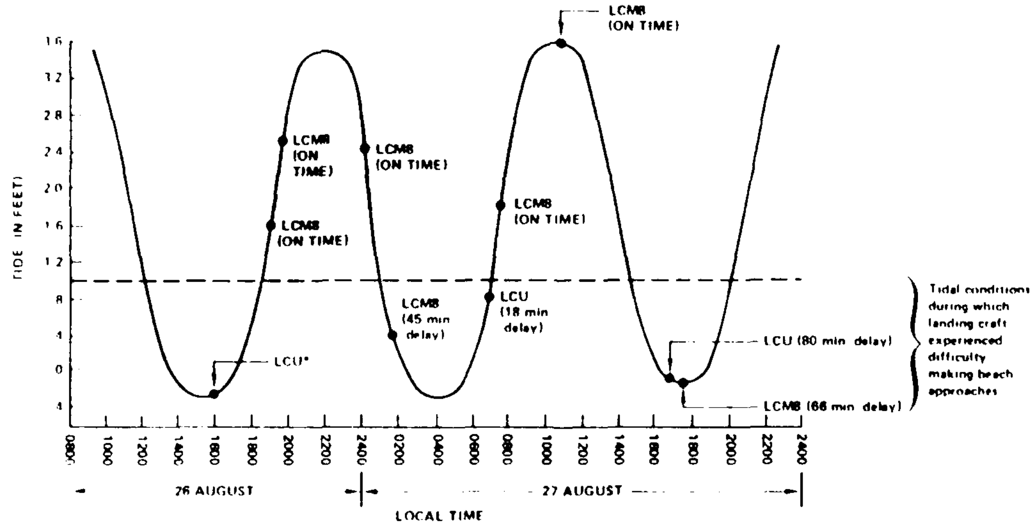
BEACH CLEARANCE ANALYSES

Landing craft once beached were rapidly unloaded and cargo was cleared through the beach expeditiously. (These times have been reported in Table 6, Section II). Although some repackaging was necessary because of broken pallets, none of the cargo was physically lost and it was properly documented throughout the clearance phase. The small quantity of cargo (351 pallets) did not tax beach operations but was adequate for training in the use of the SPS mobile terminal.

The most significant problem encountered in beach operations pertains to the beaching of landing craft. As previously discussed, the beach problem at Ft. Story involves a gentle beach gradient (2 percent) and a tidal range

(approximately 3.2 ft) that at low tide makes landings most difficult. Landing craft ground out on sandbars well off-shore. Cargo handling equipment must then work in approximately 2-3 ft of surf or more and eventually pay the consequences of salt water emersion; that is, after a period of time equipment becomes inoperable and cargo throughput is slowed or halted.

To examine this problem more closely the recorded beaching times of landing craft were plotted on a curve representing tidal high and low water conditions. (See Figure 14.) Statistically there were too few landing craft approaches made to draw specific conclusions. However, it is apparent that, in general, there is approximately a 6-hr period during low water in which landing craft will experience delays in attempting to make their approaches. The delays noted were on the order of 18-80 minutes, with the greatest approach delay occurring at low water for an LCU.



* APPROACH ABORTED AFTER 45 MIN. DELAY, LCU LANDED OVER CAUSEWAY.

FIGURE 14. TIDAL CONDITIONS DURING LANDING CRAFT BEACH APPROACHES

As more data becomes available, it will be possible to more accurately determine what kind and how much delay can be expected when landing craft make their approaches at low tide. For example, an LCM8 has a lesser draft than an LCU, but no LCM8s actually made approaches when conditions first became marginal as indicated by the dotted line. Therefore, their limits under certain tidal conditions are still unknown. Incoming and outgoing tidal currents also influence the capability of a landing craft to breach a sandbar or ground out

closer to shore. If more beachings are recorded along with the tides and sea states for analysis, it should be possible to more accurately project what operational throughput capabilities are likely to be under various conditions.

It is most apparent that, based on the difficulties experienced by landing craft in this pretest, planning for the main LOTS test will have to seek means to alleviate the situation. Some delays can be accommodated, as for example, when beach facilities are engaged in discharging lighters previously landed. At periods of low tide when the problem is most severe, crew change-overs and required equipment maintenance, which must be accomplished daily, can help minimize the effects. In general, however, operations during this period will be critical in the attainment of daily throughput objectives.

IV. CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

1. The LASH is highly suitable for the deployment of most LOTS equipment. The loading and off-loading times recorded during the pretest for vehicular cargo, the LCM8, 4 x 10 causeway (with crane), and LCM6 warping tug are realistic and can be used, as applicable, in detailed main test planning.

2. The LACV-30 has still not been test loaded on a LASH or any other ship type and should be considered for such a trial during the LOTS main test.

3. Improved methods of rigging the LCM8 lift beam and military equipment for hoisting on the LASH are required to decrease ship loading/off-loading times. The method of attaching slings to equipment with latchable hooks is superior to the use of pins and shackles.

4. The proper heavy shackles for the LCM8 lift beam, not available for this test nor for the earlier test at the Avondale Shipyard, ought to be procured and stored with the LCM8 lift beams for future use.

5. Overhead clearances on all LASH vessels need to be verified by physically measuring the distance from the gathering cones at the top position to the hatch cover, noting also the height and area of interference from barge pedestals at each corner of the hatch cover.

6. The appropriate office of MARAD should be advised of the requirement for modifying gathering cones on Alliance cranes. If called for in a military contingency or chartered for use in DoD exercises, gathering cones for C8 LASH vessels can be modified while they are in the shipyard undergoing other modifications necessary to employ the LCM8 lift beam. With prior agreement of the owners the three C9 vessels requiring modification to the gathering cones can have the work done at the time of loading.

7. For deployment from both coasts, the Services should establish a requirement for LCM8 lift beams. If any new LCM8 lift beams are to be constructed as a result of this requirement, they should be redesigned to improve overall vertical clearances.

8. For rapid deployment the causeway lifting frame is too cumbersome, complex, and slow for simply loading causeway sections. The 4 x 10 causeway was loaded with ease without a causeway lifting frame. The 4 x 10 causeway also appeared to be more stable than the 3 x 15 causeway in its cargo transfer platform role.

9. Navy LCM6 tenderboats/warping tugs were able to clear the LASH stern of barges satisfactorily in calm seas but experienced difficulties as winds increased and seas became rougher. A more powerful tug is required for LOTS operations.

RECOMMENDATIONS

1. The recorded loading and off-loading times for vehicular equipment, the LCM8, 4 x 10 causeway (with crane), and LCM6 warping tug be used as guides in main test planning.

2. The LACV-30 be test loaded during the LOTS main test.

3. The Services develop latchable hooks in lieu of pins and shackles for use with the LCM8 lift beam.

4. The shackles intended for use in hoisting an LCM8 with the LCM8 lift beam be procured and stowed as components of the lift beam.

5. The Military Sealift Command take the initiative to verify and record the vertical clearances of the barge cranes on LASH vessels.

6. MARAD be advised of the failure of the LCM8 lift beam to mate with the Alliance type cranes on LASH ships and of the modification required.

7. The Services determine the requirement for LCM8 lift beams for deployment from both coasts. If additional beams are approved for construction, MARAD should be advised to incorporate additional clearance in the design.

8. Before continuing with development of the causeway lifting frame, the Navy consider alternative loading methods such as the use of counterweights as described in this report.

9. The Navy study the advantages and disadvantages of the 4 x 10 and 3 x 15 causeways and other configurations considering their various mission roles and deployment means.

APPENDIX A

LCM8 LIFT BEAM

GENERAL

The LCM8 lift beam, originally an Army concept, was developed as a national defense feature of the C981 LASH ships. All of the ships of this class have been modified to use the beams. Basically, the lift beam is a box girder fitted to mate with either the aft or forward gathering cones of the lighter gantry crane. Sling padeyes beneath the beam allow attaching a load at either the port or starboard sides, or the center, or at a combination of these points. The beam, tested November 12-14, 1974, aboard the GREEN HARBOUR, was certified for use by the American Bureau of Shipping (ABS). Table A-1 provides some general characteristics of the beam. Figure A-1 shows the normal location of the beam padeyes.

TABLE A.1

LASH LCM8 LIFT BEAM GENERAL CHARACTERISTICS

Length	54 feet 1½ inches
Width	3 feet 4 inches
Height	7 feet 0 inches
Weight	13.84 long tons
Symmetrical lift capability (ABS)	186 long tons
Asymmetrical lift capability (ABS)	93 long tons
Number beams available	3

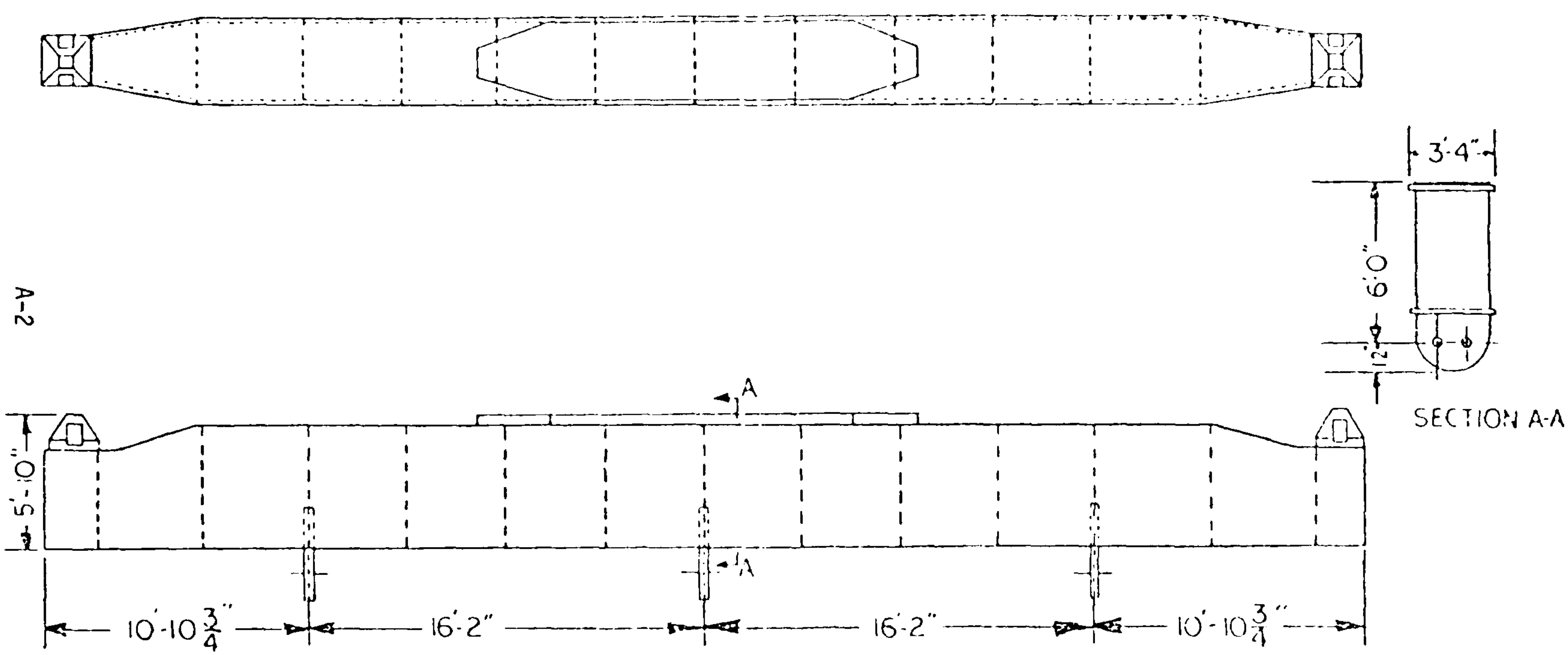


FIGURE A.1. UNMODIFIED LCM8 LASH LIFT BEAM

The three beams cited in the table above are all kept in storage at the Naval Supply Center, Norfolk, Virginia. Two of the beams were used in the pretest and have been modified as a result of the LASH ships pretest and now have additional attachment points.

In order to attach the causeway lift frame, developed as part of the Navy's Container Off-loading and Transfer System (COTS), two of three available beams had to be modified so that struts could be attached. On the beam used in the aft position the attachment points are on both sides of the beam at the top and are centered on the beam approximately the width of the causeway apart (about 21 ft). On the forward beam the attachment points are on the underside of the beam, centered, and also the width of the causeway apart from each other. These six points (four on the aft beam and two on the forward one) could be used as additional attachment points in future lifts involving either or both beams with other types of equipment. Figures A-2 and A-3 show two of the beams as modified for use with the causeway lift frame. The third lift beam, which was not used in the pretest, has not been modified.

In the LOTS pretest, the second beam was mated to the forward gathering cones on the barge crane's load frame (spreader). The aft beam was used for the LCM8, the 140-ton crane, the carrier for the 300-ton crane, the LCM6 warping tug, and the sideloader. Both beams were used for the lift of the 4 x 10 causeway section with a 30-ton crane aboard. Both beams, as noted above, were necessary for use with the causeway lifting frame to load and discharge the 3 x 15 causeway.

REQUIRED SHIP MODIFICATIONS

During the period the LASH ITALIA was undergoing a routine overhaul, an additional four days were added to the yard period for the ship modifications necessary to accomplish the pretest. Basically, the modifications were intended to do three things.

First, it was necessary to increase by approximately 2½ ft the distance aft the gantry lighter crane would travel. This was necessary so that the center of gravity for an LCM8 would be located directly under the aft LCM8 lift beam (discussed later) and still allow approximately 1 ft of clearance between the LCM8 and the ship's transom. Otherwise, the LCM8 when hoisted by the gantry crane would scrape against the transom so badly that both the ship and landing craft would be damaged. To permit the gantry lighter crane to travel further aft it was necessary to modify the circuitry so that the normal limit switches could be overridden.

Secondly, the gantry crane was designed to operate using a four point lift. This meant that the circuitry for engaging barges had to be changed. For the Alliance crane (the type on the LASH ITALIA) the combined capacity is 446.4 long tons. Thus, when the circuitry was modified to permit using the two after gathering cones, the capacity in this mode was halved.[1]

[1] For the Morgan Crane (six of the nine C981 type LASH ships, specifically, those belonging to Delta Lines and Central Gulf Steamship Corp., have this type crane), the combined capacity is 455.4 long tons or about 9 long tons greater than an Alliance crane. This capacity also must be halved if only the two sockets are used.

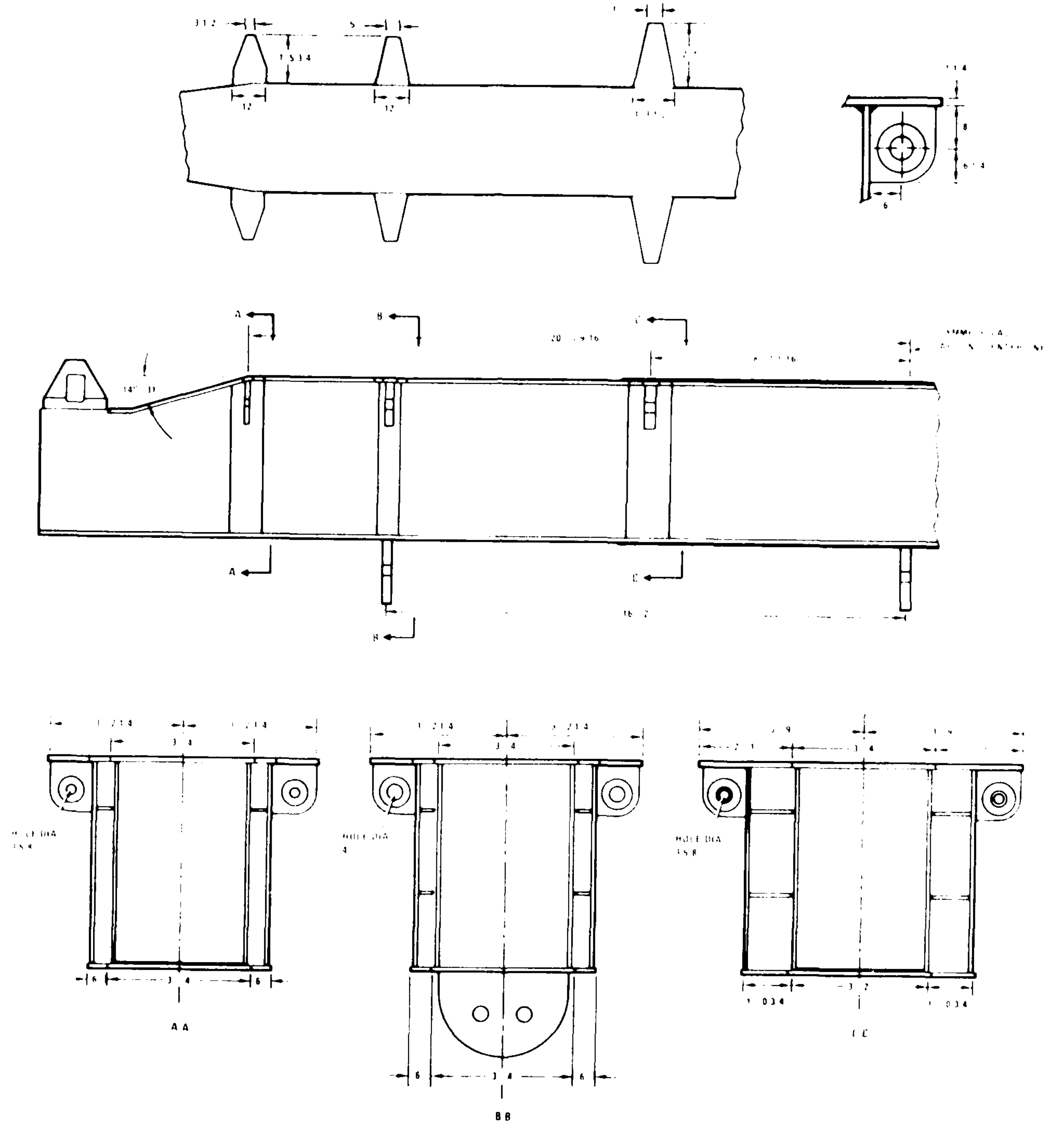


FIGURE A.2. AFT LCM8 LASH LIFT BEAM AS MODIFIED
(Beam is shown as modified for attaching the Navy lifting frame for a 3 x 15 causeway.)

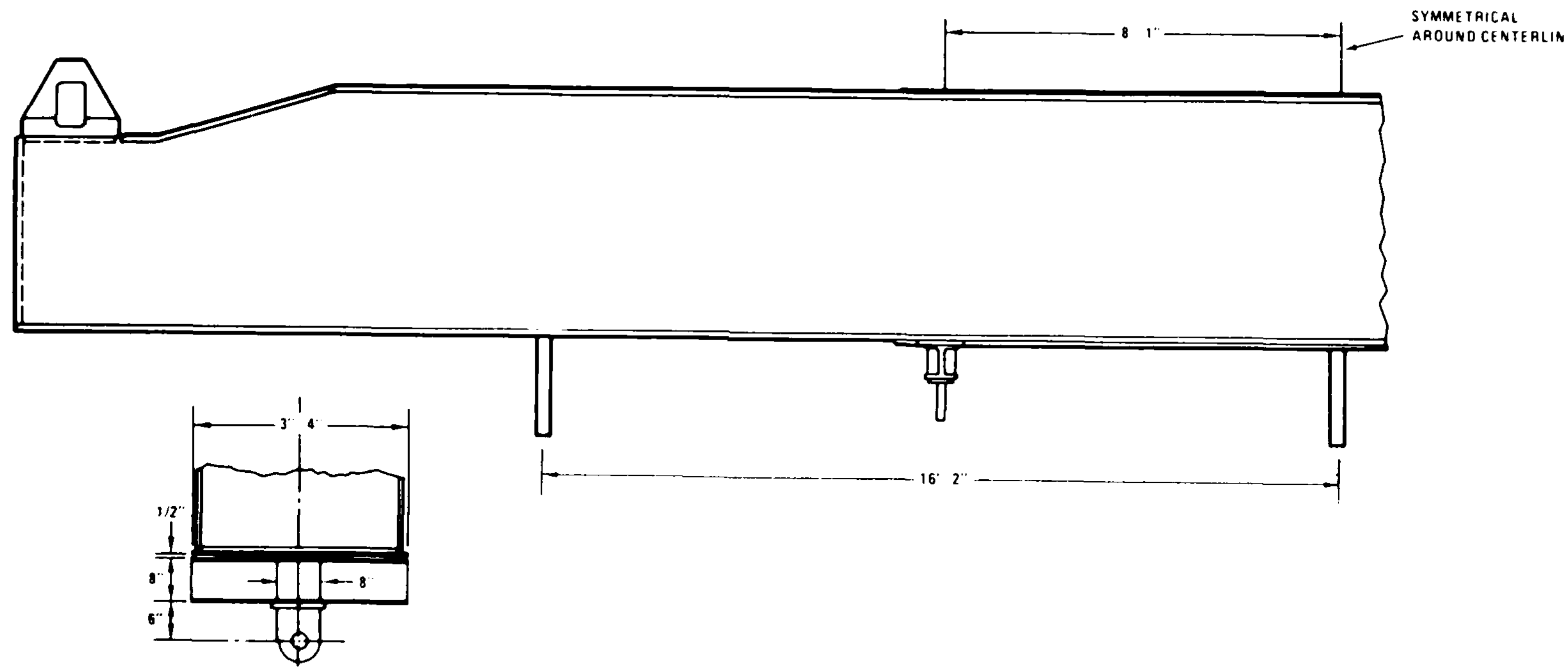


FIGURE A.3. FORWARD LCM8 LASH LIFT BEAM AS MODIFIED
(Changes are for attachment of the Navy 3 x 15 causeway lifting frame.)

Finally, the guides on the ship's stern overhang (located forward and aft on both port and starboard sides, through which the gantry crane frame is lowered) had to be moved aft. This shift coincided with the new lowering position of the crane. This process for the C981 is a matter of unbolting and moving the guides to alternate positions. For the C881 it was necessary to modify the stern so that the guides could be bolted into the new positions which were $2\frac{1}{2}$ ft further astern.

UNPLANNED SHIP MODIFICATION

An unanticipated pierside ship modification proved crucial to the conduct of the test. Because the LCM8 lift beam had never before been used on a C881 (with its Alliance crane), there had never been any verification that the lift beam would, in fact, work with that class ship. The LASH pretest established that without modification it might not. Heretofore, assumptions had been made on the basis of a test[2] conducted on a C981 LASH, the SS GREEN HARBOUR which has a Morgan crane, that the beam could be universally employed by LASH vessels.

Both LCM8 lift beams were placed on the deck of the LASH ITALIA. When the load frame was unable to engage the first lift beam, the second was tried. When it failed it was apparent that some modification was in order before the pretest could continue.

The gantry crane's lifting frame has four gathering cones that normally mate to four lifting points on a LASH barge. The lifting frame has a horizontal locking bar that slips through the gathering cone, the lifting point, and back through the gathering cone again to fully engage the barge or LCM8 lift beam before hoisting. It was discovered that a raised lip on the inboard edge of each gathering cone came into contact with the top of the lift beam too soon, preventing the lifting points on the LCM8 lift beam from being fully seated in the gathering cone. As a result, the locking bar that was to pass through both was unable to engage and secure the beam.

Upon determination of the problem, it was evident that the lift frame (see Figure A.4) could not be modified on-the-spot. On the other hand, it appeared possible that approximately 2 inches of the inboard lip of the gathering cone could be removed without impairment of the ship's capability to lift barges. The ship's captain and Prudential Lines did agree to this critical modification and two cutting torches were subsequently used. Once the decision was made, the cutting of the four gathering cones required approximately $1\frac{1}{2}$ hr. Approximately 45 minutes after the cutting was completed the two LCM8 lift beams were successfully installed on the gantry crane's lift frame.

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[2] Avondale Shipyard, New Orleans, La., 12-14 November 1974. See Civil Engineering Laboratory, NCBC, Port Hueneme, Ca., report entitled LCM8 Lift Beam Tests—Outsize Lift Capability Added to the LASH System, by D. A. Davis, dated February 1975, Report No. 55-75-05.

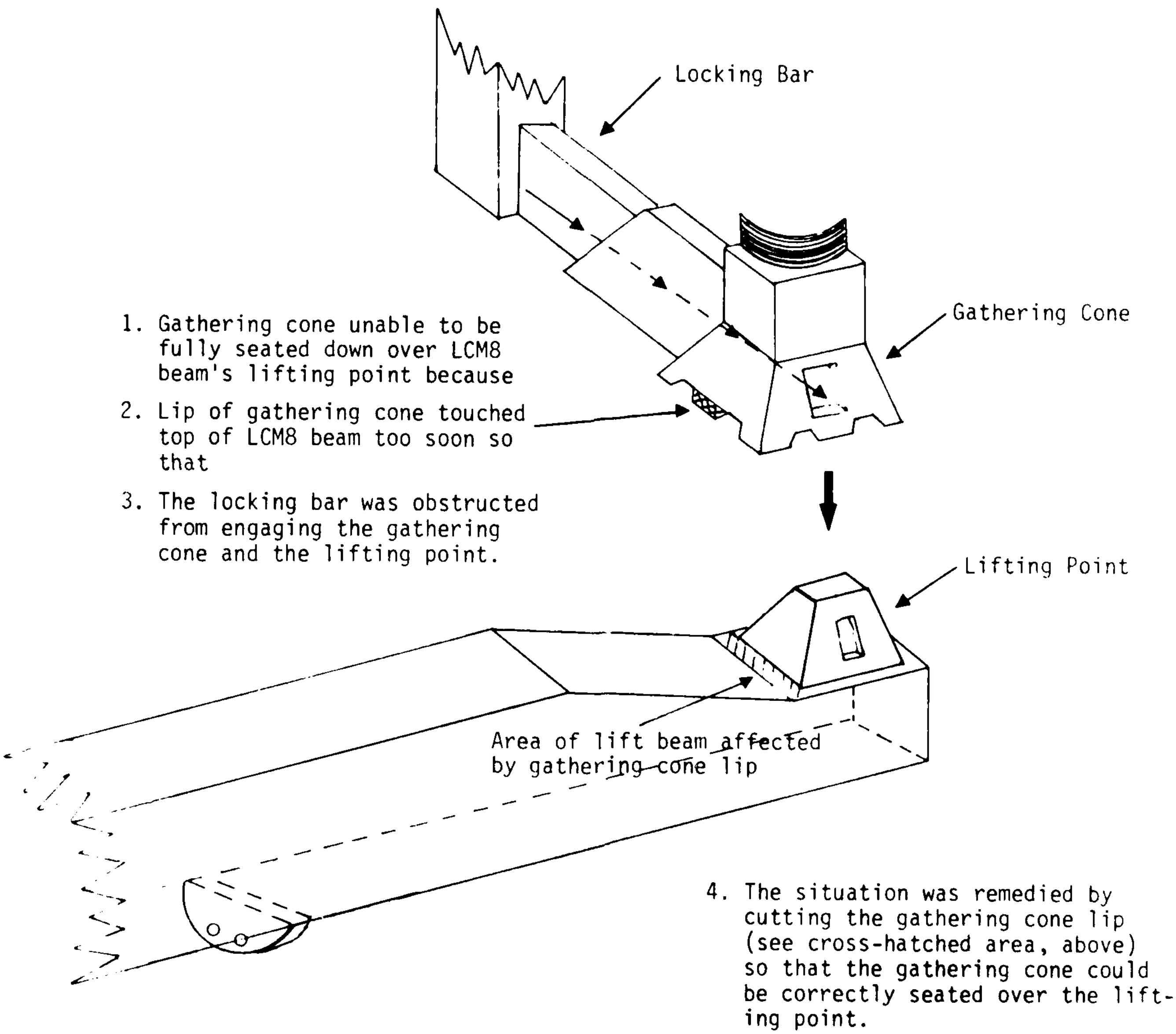

FIGURE A.4. ILLUSTRATION OF FAILURE OF LASH GANTRY CRANE TO ENGAGE LCM8 LIFT BEAM

APPENDIX B

USE OF LASH VESSELS FOR DEPLOYMENT OF LACV-30

This appendix describes results of studies and engineering calculations made with a view toward lifting a LACV-30 aboard a LASH ship equipped with an LCM8 lift beam. No test of the concept has been undertaken as of the date of this report because the LACV-30 was not available for such use at the time of the LASH ship pretest. The calculations show that such a lift is feasible. The advantages of ship speed and space aboard made the use of the LASH ship desirable for deployment of the LACV-30.

BACKGROUND

No overhead clearance problems are anticipated in lifting an assembled LACV-30 onto the open deck of an ordinary breakbulk ship using the designed LACV-30 lift points. Unfortunately, these same lift points do cause clearance problems when the LASH gantry crane and the LCM8 lift beam are used to lift the LACV-30 aboard the LASH ship. The lift appears feasible, however, if the effective center of gravity is moved forward by means of a counterweight and different lift points are used along with a load spreading device. As of the writing of this report no trial has yet been made in which the craft was lifted. However, such a trial lift without a LASH ship but using a load-spreading rig made from standard commercial components procured for the purpose is expected to be made in the Spring of 1977.

THE TECHNICAL PROBLEM AND ITS SOLUTION

Clearances and Center of Gravity Location

To lift a load like the LACV-30 and have it remain horizontal, the center of gravity must be directly below the suspension point. As a matter of clearances, lifting the LACV-30 aboard a LASH ship with the LCM8 lift beam

requires that the horizontal distance between the center of gravity of the craft and the stern of the ship be limited to approximately 32 ft. Ordinarily the center of gravity is near the middle of the craft, which is just over 76 ft long, so that the center of gravity is about 38 ft from either end. Some adjustment of this location is possible by shifting fuel from one tank to another, but such a shift will not accommodate the difference between 38 ft and 32 ft. Assuming a swing crane is in place at the bow, a counterweighting on the order of 6 short tons located well forward will result in the combined center of gravity location being the required distance from the craft bow.

Use of Cargo Tie-Downs as Lift Points

With the center of gravity so located, the LACV-30 would clear the LASH stern and would hang horizontally, but a problem remains. The designed lifting eyes are appropriate for the unshifted center of gravity. To make the lift, provision must be made for a different location for the lift points. There are cargo tie-down points available. The stresses from lifting from single tie-down points, however, would be considerably greater than they were designed for. Accordingly, an arrangement of load-spreading lift beams was devised that ensure that the lift load is spread exactly even among 16 tie-down points.[1] This arrangement is known as a "whiffle-tree" rig and is sketched in Figure B.1.

DIRECTIONS FOR LIFTING LACV-30 ON LASH USING LCM8 LIFT BEAM

LACV-30 Configuration for Lifting

The LACV-30 will have the swing crane in place, but the swing crane feet are to be removed and lashed on deck as far forward as possible. Fuel tanks will have half fuel or less. Approximately 3/4 of the ballast fuel will initially be in forward tanks, but one operator will at first remain to adjust ballast as necessary to make the LACV-30 ride level when first lifted clear of the water. Fenders will be in place.

A counterbalance weight of 8 to 10 tons will be necessary[2], placed on deck as far forward as possible. The LACV-30 cannot operate on a cushion with the center of gravity as far forward as is necessary for the LASH lift. The counterbalance weight, then, must be positioned after the craft comes off cushion and, furthermore, must be removed or moved before the craft can operate again.

The LACV-30 plus counterweight must hang horizontally with the lifting hook directly over station 364½. This is the mid-point of the whiffle-tree

[1] An informal opinion from a Bell Company engineer, who originated the use of the load spreading arrangement was that for a production model of the LACV-30 stronger dual-purpose fittings for tie-down and for LASH lift could be designed that would obviate the need for the load spreader described.

[2] Exact size of the counterbalance weight depends on how far forward it can be placed.

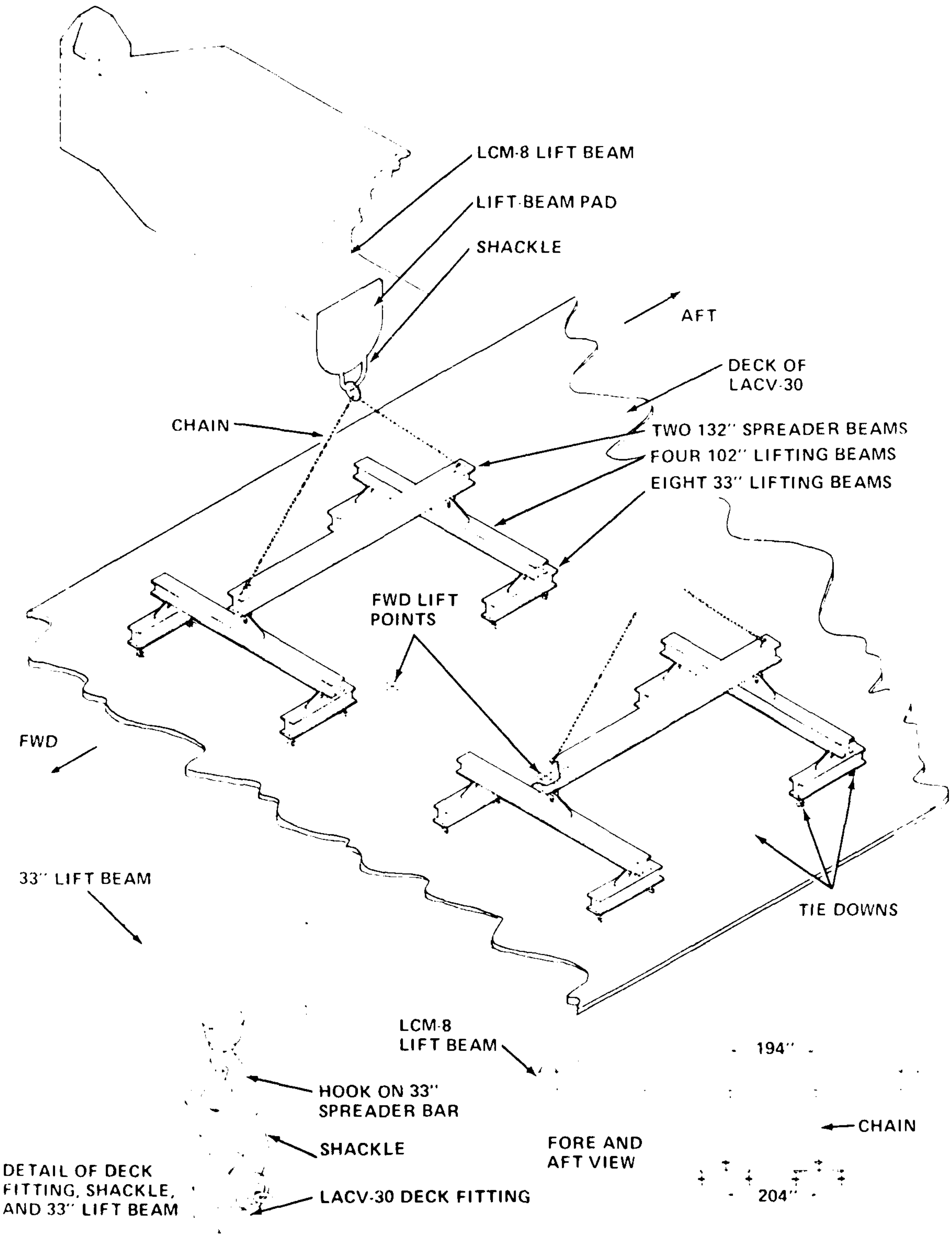

FIGURE B.1. SKETCH OF LACV-30 WHIFFLE TREE ASSEMBLY
(Used for lift of counterweighted LACV-30 using LASH LCM8 lift beam.)

lifting arrangement. The placement and weight of the counterweight will be determined during a practice lift. Some deviation from the conditions of the practice lift can be compensated for by moving ballast fuel as required.

A suitable counterweight would be any readily moved weight. One solution would be to use a tank holding approximately 350 cu ft of sea water (2,600 gallons), together with a pump for filling or emptying the tank in a reasonable time. Preferably the tank will have two compartments (i.e., it should be divided by a centerline bulkhead) to avoid surge problems from rolling in a seaway.

Procedure During Lift

The crane will move into the LASH lifting area with the bows of the LACV-30 and the ship both pointing in the same direction. In other words, the bow of the LACV-30 will move in toward the stern of the ship.

When the lift commences it is important that the first strain be taken slowly. The water in the compartments of the LACV-30 must be given a chance to drain out as the LASH crane starts its lift. If the strain is taken too quickly a heavy weight of water will be trapped in the craft and the total weight could be too great for the structure of the LACV-30.

Clearances

The horizontal distance from the bow of the LACV-30 to the center of gravity of the counterweighted LACV-30 (i.e., to station 364) is 31 ft, 2 in. The available space is 32 ft, 9 in. Thus the available horizontal clearances between the stern of the LASH and the bow of the LACV-30 is only 1 ft, 7 in.

The vertical height of the whiffle-tree assembly, from the LACV-30 deck to the top two 25-ton shackles at the top of the rig is 15 ft, 1 in. To this must be added the distance from the LACV-30 deck down to the bottom of the LACV-30 landing pads— 4 ft, 2 in. The total is 19 ft, 3 in. The minimum vertical clearance of the LASH gantry crane is assumed to be 23 ft, 9 in. This leaves a difference of 4 ft, 6 in. for the needed shackle arrangement at the LCM8 lift beam and for the LACV-30 skirt. This assumes that the LACV-30 is perfectly horizontal (level).

An error in longitudinal center of gravity location would induce a tilt to the LACV-30. This would decrease the available clearance. An error of 4 in. in the center of gravity location would cause a tilt of 2 degrees. This would make the bow or stern of the LACV-30 approximately 16 in. lower than if the LACV-30 were level fore and aft.

Assembly of Whiffle-Tree Rig

The assembly will take place well before the LACV-30 is ready for positioning for lift by the LCM8 lift beam on the LASH ship.

The following are the steps in assembly:

a. Place the 16 seven-eighths-inch size shackles into tie-down points. The shackle pin is 1 in. in diameter and goes through the hole in the tie-down fitting. The 16 tie-downs are in four rows across the craft. In each row there are four tie-downs across, one in each of the four longitudinal rows of fittings.

   The tie-down fittings are smaller than the lift point fittings, which are identifiable by a plate in the deck. The 16 tie-down fittings to be used can be found as follows:

   1. Starting at the two forward lift points, move further forward 33 in. and 66 in. to the first and second thwart ship row of four tie-downs. These eight points are each to be fitted with a shackle. Then start back at the labelled lift points again. Move aft to the second thwartship row. (A total of 66 in. from the lift points.) This row of four tie-downs, and the row immediately aft of it, are the second set of eight tie-downs to be fitted with shackles. Note that when finished there will be two rows of shackles each 33 in. apart forward and two rows 33 in. apart aft of the tie-downs.

b. Hook each end of the eight 33-inch lift beams into the shackles, thus connecting together pairs of tie-downs. The long axis of the beams will be fore and aft, and the eye in the middle of each will be up. Support the beams above the deck with pairs of wood blocks. These should be uniform in height but can be any height between 6 inches and 9 inches. These blocks will take the weight of the 33-inch lift beams and the remainder of the whiffle-tree, and prevent marring the deck of the LACV-30.

c. The eye in the middle of each of the 3-ft lifting beams should be upward. The hook at each end of the 8½-ft lift beams is hooked into each 3-ft lift beam eye, thus connecting together the centers of the short lift beams.

d. The two 11-ft spreader beams have a chain at the top and have a hook at the bottom of each end. Each hook fastens to the center of one of the four 8½-ft lift beams.

e. The eye in the chain on each spreader beam is connected to the LCM8 lift beam pad. One chain eye is connected to the middle lug of the lift beam, the other chain eye goes

to one of the side lugs. (This means tnat the centerline of the LACV-30 will be parallel to and approximately 8 ft from the centerline of the ship.)

f. During the trip to the ship and away from it the only shoring necessary for the lift rig are the timbers under the 3-ft lift beams. The other parts of the whiffletree rig will rest on top of the 3-ft beams. The rig should be lashed down for safety.

Tie-Down of LACV-30 Aboard Ship for Sea Voyage

Aboard the ship (a LASH or other vessel) certain precautions must be taken so the forces on the LACV-30 resulting from the motion of the ship in a seaway can be properly handled. A cradle should be built from dunnage timbers. Four shallow sockets should be provided in the cradle, into which the four polyeurethane landing pads on the craft will fit. These landing pads are designed to take sidewise loads. The sidewise inertial loads from the weight of the craft can thus be transferred to the cradle, which of course would have to be tied down itself.

The tie-down of the craft to the cradle involves restrictions. The basic requirement is to resist "negative g loads" (when the ship tends to move downward faster than the craft). Tie-down lines or chains to resist such inertial forces can be fastened to the forward and after towing fittings. Tie-downs cannot lead around the sides of the craft as the sides are not strong. As mentioned, though, the landing pads are built to take side loads.

Lowering the craft onto the cradle in the correct location may present minor difficulties, because the craft skirt will interfere with seeing where the landing pads are. However, if a crew of men is available to lift an appropriate part of the skirt, the landing pad locations can be seen.

APPENDIX C

CAUSEWAY LIFT OPERATIONS

BACKGROUND

It was anticipated that the most difficult lift would be the Navy 3 x 14 causeway warping tug. Lifting of the 3 x 14 causeway warping tug, which is a self-propelled modification of the Navy's basic 3 x 15-configured causeway pontoon, is a deployment requirement under the Navy's Container Off-loading and Transfer System (COTS) program. Non-availability of a 3 x 14 causeway warping tug required that a 3 x 15 causeway section properly weighted, be used instead.

Due to the length of the causeway, approximately 92 ft., the center of gravity lies outside the plane aft of the LASH ship's gantry crane. Therefore, a 3 x 14 or 3 x 15 causeway section requires a counterbalance forward. This would then permit the LASH gantry crane to hoist the causeway without tipping.

Earlier design studies by the Navy indicated that a cantilever[1] device could be used to lift causeway sections and other outsized equipment. Accordingly, it was in the Navy program to sponsor development of a cantilever lift frame at a later date. However, a simplified version incorporating the use of two modified LCM8 lift beams, the modifications to which are described in Appendix A, was rushed to completion for the LASH ship pretest. This lift

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[1] J.J. Henry Co., Inc., LASH Amphious Post-Assualt Support Mission, Phase I - Comceptual Design Analysis, prepared for David W. Taylor, Naval Ship Research and Development Center, dated 1 March 1976.

frame, pictured in Figure C.1, was delivered just before outloading operations commenced. Due to the late delivery, Navy personnel had no opportunity for practicing the assembly and disassembly of the lift frame.

ASSEMBLY OF CAUSEWAY LIFTING FRAME

The causeway lifting frame was hoisted aboard by a floating crane. Approximately 2½ hr. were spent attaching the causeway lifting frame to the LCM8 lift beams. Six heavy struts had to be attached first to the lift beams. Two were attached directly under the forward beam and were designed to transmit the upward compressive load from the causeway due to the center of gravity being behind the aft lift beam. The other four struts were connected near the tip on the forward and aft sides of the aft lift beam. These four acted as tension members. These beams were last-minute substitutions for special heavy chains called for in the initial design but which could not be delivered in time by the vendor. The attachment of the struts proved to be a time-consuming effort because of too close tolerances for pins and fittings. The causeway lifting frame was attached to the two LCM8 lift beams, the frame was then rigged for attaching the causeway, after which the lift frame was ready to commence hoisting.

Causeway Lifts

The first causeway lift attempted was intended to represent a fully equipped 3 x 14 warping tug weighing a total of approximately 152.5 short tons. The lift included a sufficient weight overload capacity so that the American Bureau of Shipping (ABS) would certify the lifting frame. Approximately 84 short tons in weights were spread along the 92-ft. length, with about 50 short tons positioned under the ship's gantry crane. The weights, repositioned at the last minute, were shifted at the request of the American Bureau of Shipping representative. As rearranged, there were only about 39 tons of the weights under the gantry crane and the remainder spaced along the causeway. This arrangement shifted the center of gravity further aft of the ship's gantry crane but was intended to be more representative of the weight distribution of a 3 x 14 causeway warping tug.

At 2220 the causeway lift was finally attempted. As the causeway came out of the water, its forward end began rotating forward and upward. As the aft end of the causeway was rising more slowly than its forward end, the weighted causeway abutted the ship's transom. At the same time the load frame of the ship's gantry began to tilt. The causeway lift was stopped at that time and the causeway returned to the water. As a result of the test lift, the lifting frame was not certified for hoisting a load equivalent to the warping tug. The combination of the heavy weight and its location too far aft now appears to have exceeded the causeway lifting frame's capability as a cantilever.

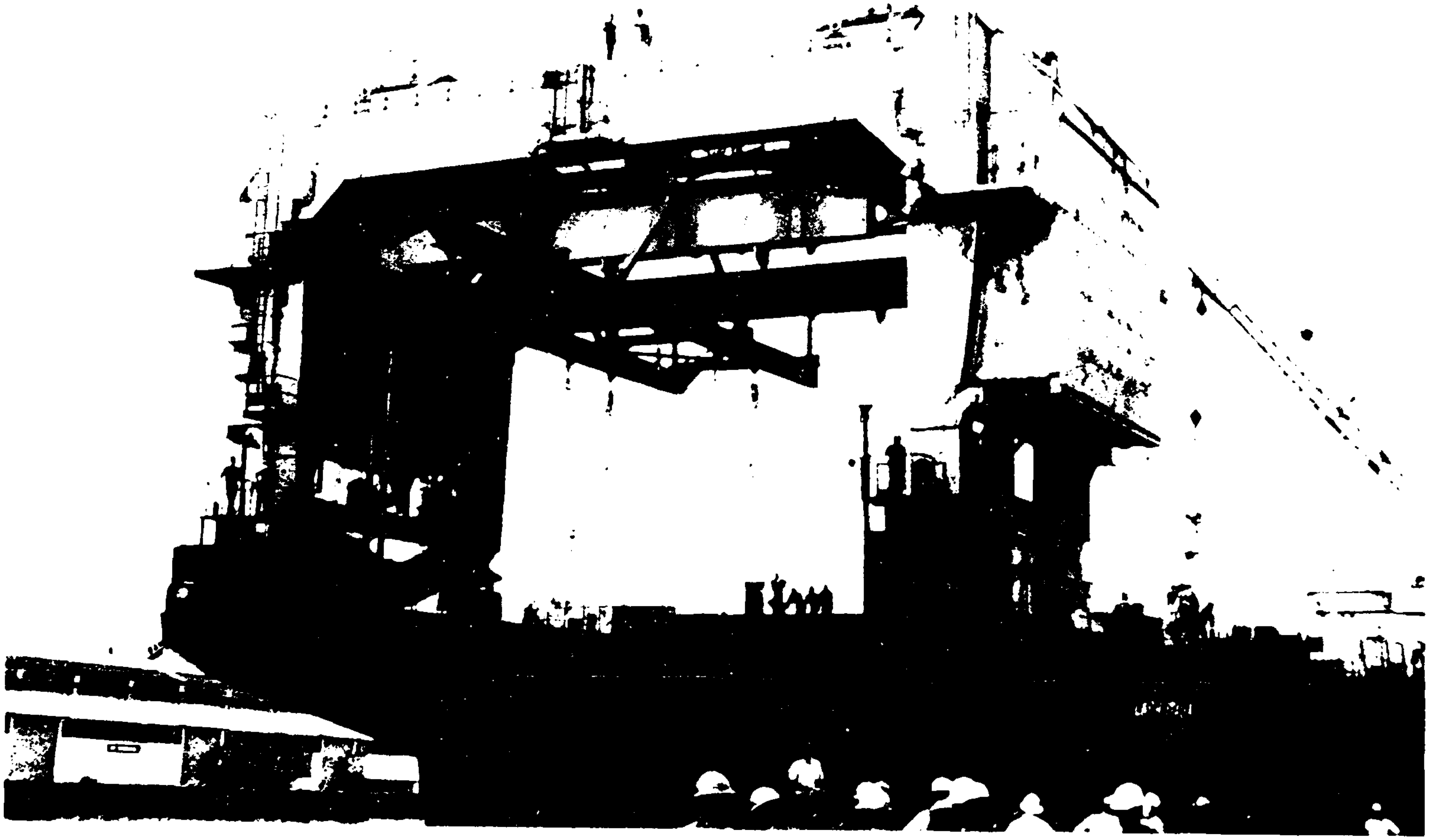

FIGURE C.1. NAV[illegible] OF [illegible]SEWAY LIFTING FRAME ASSEMBLED ON LASH LIGHTER GANTRY CRANE

An explaination for the aborted lift is offered in the event that future use is made of the causeway lifting frame. The design of the LASH gantry includes provision for a swell-compensating system to take care of heaving and rolling motions of the LASH barge in a seaway. According to a paper by a designer of one of the two available crane systems[1], the load frame of the gantry is free to tilt and move with a barge in a sea way. The load frame is a flat rectangular structure with four bell-shaped guides or "gathering cones" at its corners. These guide the frame onto the corner lifting posts of the barge. The load frame also mounts the hoisting sheaves. It thus serves as an intermediate member between the barge and the four sets of wire ropes that lift the barge. The hoisting sheaves are mounted on the load frame by special linkages called "swell arms." These arms fold or extend to compensate for roll and heave motions. It should be noted that the roll motion of a LASH barge is the same as pitch motion for the causeway, since the LASH barge is hoisted with its long axis across the ship while the causeway has its long axis parallel to the ship centerline. The gantry load frame is free to tilt and did so during the lift simulating the causeway warping tug. The reason it did was because the center of gravity of the total assembly consisting of the load frame, the two LCM8 lift beams, the causeway lift frame, and the causeway was located aft of the after hoisting sheaves. As a result, the crane lift frame with its motion-compensating mechanism began to tilt until near the limit of its angular capability. At that point the lift was halted.

A different lift of the causeway was successful the next day. One 7-ton weight was left in the center of the causeway and all others removed. The causeway was reattached to the causeway lifting frame and the lift was successful with the lightened load, although the aft end of the causeway was approximately 12-18 inches lower than the forward end. The causeway lifting frame was certified by the ABS representative for lifts up through 70 short tons. The causeway was then lowered onto the deck of the LASH. Rough calculations of the location of the combined center of gravity of the load frame, lift beams, and the lesser load show the location to be forward of the after hoisting sheaves (i.e., between the aft and forward sets of sheaves). For this reason, it is further hypothesized, the lift frame did not rotate during the second lift of the causeway. Approximately 1½ hr. were required to detach the causeway lifting frame from the LCM8 lift beams. The same problems relating to close tolerances of pins and fittings also contributed to the lengthy disassembly time as sledge hammers were required to force pins loose.

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[1] Axins, R., "Engineering a 510-Ton LASH Crane," Iron and Steel Engineering Magazine, Morgan Engineering, Co., July 1970. (Note that while the crane described in this reference is not the Alliance crane actually used in the pretest, the general behavior and characteristics are similar.)

APPENDIX D

BREAKBULK CARGO THROUGHPUT OPERATIONS

As an adjunct to the equipment deployment evaluation, four LASH barges loaded with palletized and vehicular cargo were also loaded and a breakbulk throughput operation was established. Since most operations of this nature have been done on the West Coast, this pretest add-on gave East Coast LOTS exercise participants an opportunity to conduct throughput operations using a floating cargo transfer platform. Navy personnel augmented with some Army personnel operated the transfer platform. Army and Navy landing craft were used to lighter cargo ashore. Army personnel provided beach clearance support.

EQUIPMENT TO SUPPORT THE TRANSFER PLATFORM

One of each type of equipment necessary for establishing a floating cargo transfer platform was embarked on the LASH ship to demonstrate the deployability of the system. These items were a 4 x 10 causeway section with a Navy P&H model 640 crawler crane (30-ton lifting capacity) mounted on it, and a 3 x 15 causeway section. The floating platform when completed consisted of the 4 x 10 causeway with crane and a 3 x 15 causeway attached at each end (see Figure D.1). LCM6 warping tugs and tender boats were used to assemble the platform and position LASH barges. A mooring buoy approximately 800 yards off Green Beach, Ft. Story, Virginia, was used to hold the floating cargo transfer platform in position. Another mooring buoy was used to hold the barges until needed for unloading at the platform.

Other required equipment for floating cargo transfer platform operations included camels (logs banded together) to act as fenders and absorb some of the shock of barges and lighters tied up alongside; two 4,000-lb capacity forklifts to move cargo within the barges to positions accessible to the crane's hook; a floodlight unit for night operations; crane maintenance and support material for refueling, greasing, rigging changes, and minor repairs; and a portable sanitation facility.

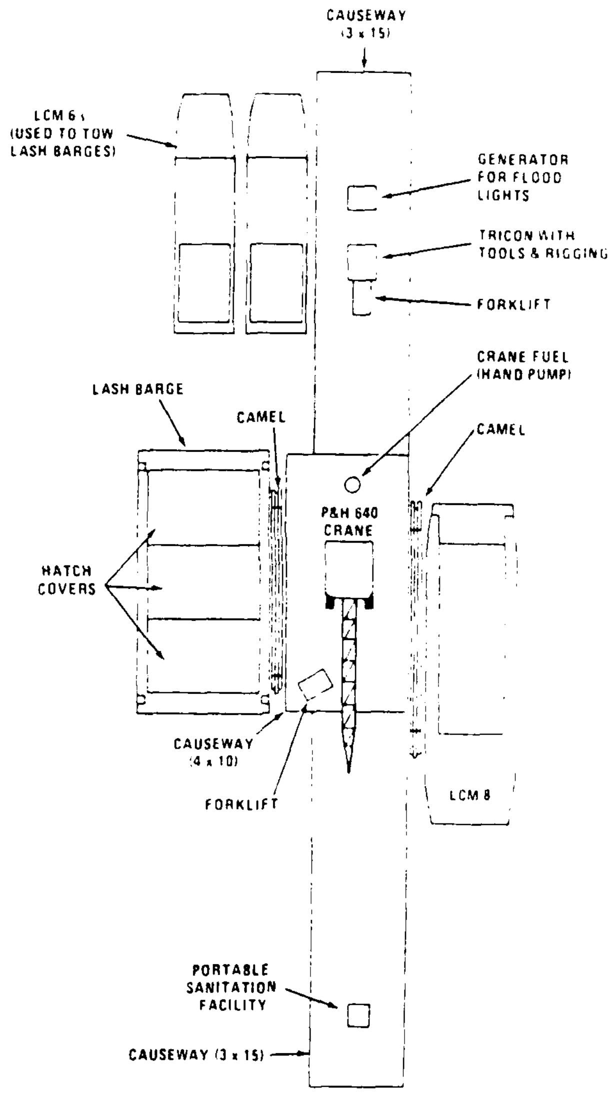

FIGURE D.1. FLOATING CARGO TRANSFER PLATFORM USED IN LOTS LASH SHIP PRETEST

THROUGHPUT SUPPORT OVERVIEW

Cargo was off-loaded from a LASH barge positioned on one side of the platform and transferred by the crane to a lighter positioned on the opposite side of the platform. LCM8s and LCUs were used to transport the cargo to Red Beach where the transfer from lighters to trucks was made. Red Beach was selected for the beach transfer because it did not have as severe a sandbar problem as Green Beach.

Red Beach operations were conducted 26-28 August. Four 6,000-lb capacity rough terrain forklifts were used for unloading lighters. Bulldozers were available in the vicinity to assist vehicles through the sand. Routine procedures were used for discharging lighters. One forklift picked up pallets in the lighter and deposited them on the sand approximately 30 yards away. A second forklift would then load trucks as they became available on the beach.

Cargo movement across Red Beach was picked up and its movement monitored by a documentation control team employing a mobile van that provided a data link to a logistic base supporting the Army's Standard Port System (SPS). The SPS mobile van performed limited water terminal cargo data processing operations. Like the floating cargo transfer platform, use of the SPS was an adjunct to the Joint LOTS LASH Ship Pretest.

OPERATIONS AT FLOATING TRANSFER PLATFORM

Once the LASH barges were off-loaded from the ship, they were taken under tow by either LCM6 warping tugs or LCM6 tender boats to the floating cargo transfer platform site. Initially, the barges were moored to the nearby second buoy using a Christmas Tree mooring technique until the cargo transfer platform was ready. Then the barges were individually called over to the platform where the crawler crane transferred the cargo to landing craft.[1]

Operations on the floating cargo transfer platform commenced with the arrival of the first LASH barge at 1230 on 26 August. Unloading continued around-the-clock until terminated at 1740 on 27 August when a crane failure occured that could not be repaired. Because the transfer operation was an adjunct, no instrumented wave recordings were made, although data collectors did make observations on the sea state. A detailed description of events follows.

Preparations for Barge Unloading

The center hatch cover of a LASH barge was normally the only one of the three removed in order to off-load cargo from the barge. In removing the center cover, tagline handlers could stand on the two end hatch covers. This permitted them to be on both sides of the hatch cover being lifted. However, in moving the center cover, working space was limited and they had to be alert

[1] LASH barges are not designed to be beached before unloading. Their draft can be as much as 8.8 ft when fully loaded (413 short tons) and their overall height is 12 ft. Their loading/unloading is normally done pier-side.

to prevent being hit by the pendulating hatch cover. If an end cover was being lifted, tagline handlers stood on the center hatch cover. In this case there was not sufficient working space on the outside of the end hatch cover for handling taglines, making the operation more difficult. The end covers also provided a guide for the center cover when it was being replaced. Once removed, hatch covers were stored on the cargo transfer platform. Only one iteration of center hatch cover removal was timed and it required 11 minutes. The replacement of three center hatch covers took 13, 12½, and 13 minutes, respectively.

The next step in off-loading cargo from a LASH barge was to unlash the cargo. For the first barge, which contained vehicles, this required approximately ½ hr. The cargo in the center of the barge was off-loaded first. For barges with palletized cargo, a forklift was then lifted from the floating cargo transfer platform into the barge. The forklift moved the remaining cargo to the middle of the barge so the crane could off-load it through the center hatch.

Cargo Description

The four barges discharged from the LASH ITALIA contained a variety of test cargo. Barge number 070 was loaded with vehicles and forklifts as listed in Table D.1.

TABLE D.1

CARGO ON BARGE 070

Cargo Description	Quantity
Trailer, utility	1
Truck, ¼-ton utility	1
Trailer, 1½-ton cargo	2
Truck, 2½-ton cargo	2
Forklift, 4,000-pound	2
TOTAL	8

Barge number 386 carried 63 rolls of concertina wire and 167 pallets, a total of 230 items. The cargo description and quantity are in Table D.2.

TABLE D.2

CARGO ON BARGE 386

Cargo Description	Quantity
Concertina wire-rolls	63
Pallets-sandbags	96
Pallets-barbed wire	37
Pallets-metal stakes	32
Pallets-contents unknown	2
TOTAL	230

Barge number 144 had 143 pallets on board (see Table D.3). The test was terminated before all the cargo on this barge was off-loaded. The barge had 22 pallets on board when operations were stopped. No cargo was transferred from the fourth barge.

TABLE D.3

CARGO ON BARGE 144

Cargo Description	Quantity
Pallets-sandbags	11
Pallets-metal stakes	12
Pallets-C-rations	79
Pallets-compressed fuel	19
Pallets remaining on the barge after the crane failure	22
TOTAL	143

Barge Cargo Off-Loading Times

Cycle times are given for the three types of cargo: vehicles, concertina, and palletized cargo. The vehicles were the first cargo transferred and their cycle times are given in Table D.4.

TABLE D.4

CYCLE TIMES FOR VEHICLES

Cargo Description	Cycle Time (Mins.)
Trailer, utility	6
Truck, ¼-ton utility	7
Trailer, 1½-ton cargo	28
Trailer, 1½-ton cargo	16
Truck, 2½-ton cargo	11
Truck, 2½-ton cargo	10
Forklift, 4,000-pound	4
Forklift, 4,000-pound	12

Eleven lifts of concertina wire were made. Interruptions were encountered during six lifts. Cycle times and the reasons for the interruptions are given in Table D.5.

TABLE D.5

CYCLE TIMES FOR CONCERTINA

Number of Rolls per Lift	Cycle Time (Mins.)	Reason for Interruption
6	22	
4	15	
4	–	Change lighters
4	–	Inspect crane
5	–	Change hook on the crane
7	–	Fouled crane cable
8	–	Repositioning lighter forward
8	–	Change lighters
7	15	
3	3	
7	7	

A total of 125 pallets were transferred from the LASH barges to lighters. Nine cycles were interrupted and timings were not completed due to lighter changes, camel repairs, a lunch break, and a forklift exchange. The average cycle times for the remaining 116 pallet lifts are given in Table D.6.

TABLE D.6

AVERAGE CYCLE TIMES FOR PALLETS

Type of Pallet	Number of Lifts	Average Cycle Time (Mins.)	Average Number of Pallets per Lift
Sandbags	33	4.2	2.5
Mixed	15	4.5	2.4
Metal stakes	15	3.6	2.1
Barbed wire	9	5.1	2.1
Compressed fuel	9	3.4	2.0
C-Rations	35	4.1	2.0

Other Observations

The cargo transfer platform was used as a temporary pallet holding area in one instance when a lighter was not immediately available. Twelve pallets from LASH barge number 386 were first landed on the causeway and then transferred when the next lighter was moored.

Some of the cargo and pallets were observed to be in poor condition which slowed cycle times in certain instances. For example, metal posts were not secured sufficiently on one pallet and fell off.

The forklift used for repositioning cargo to the center of the barge for off-loading was transferred to the floating cargo transfer platform once the barge was empty. Two timings made for this evolution were: 5 minutes and 1[illegible] minutes.

One barge mooring was timed at 22 minutes. Two barges were cleared from the platform in approximately 5 minutes and 13 minutes. The mooring of landing craft required from 3 to 15 minutes. . .the 15 minutes was in a fairly rough sea. Only one timing of landing craft casting off was made and the 15 minutes required appeared to be typical.

As the sea state increased, problems were encountered with mooring lines parting. For example, at 1610 on 26 August, a five-inch circumference (approximately 1½-inch diameter) mooring line to LCU 1510 parted and at 1710 two additional 5-inch mooring lines to the same LCU parted. The LCU cast off and was replaced by an LCM8 that could be held by the available mooring lines. At 1631 it appeared that a 4-inch (approximately 1¼-inch diameter) barge mooring line was about to part, so a new one was installed. In the future the Navy recommends using 5-inch mooring lines for barges and craft up to the size of an LCM8 and 6-inch (approximately 2-inch diameter) mooring lines for LCUs.

RED BEACH OPERATIONS

Lighterage operations on Red Beach began at 1545 hours on 26 August 1976 when LCU-1661 attempted to make a landing. All of the vehicles and trailers were landed on the beach by 1639 and their progress monitored until delivered to the consignee.

Rough terrain forklifts off-loaded lighters at the shoreline and moved the cargo to the beach marshalling yard. Times required to unload the lighters are given in Table D.7.

Documentation personnel processed the cargo tallies and delivered them to the mobile van. This action initiated intransit accounting for the cargo. Forklifts then moved the cargo from the marshalling yard to the trailers spotted for port clearance. With completed documentation (transportation control and movement document-TCMD), the cargo was delivered by truck to consignee.

The documentation and movement control of cargo was handled without great difficulty, other than the inconvenience of having to use couriers. During the period 1545 hr, 26 August, to 0715 hr, 27 August, a total of 67 line items of cargo had been off-loaded over Red Beach. Some redocumentation was necessary when six pallets of exercise cargo came apart and had to be repacked in the marshalling yard prior to forwarding to the consignee.

One of the major problems at the beach was getting a dry ramp for landing craft. In low tidal conditions both LCUs and LCM8s had difficulties and, as a result, delays were incurred making their approaches. This is due to the rather gentle two percent gradient and 3.2 ft tidal difference.[*] Table D.8 gives the beach approach times for the lighters.

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[*] Operations Research, Inc., Report on Results of the Conventional Breakbulk Ship Pretest of the Joint Logistics-Over-The-Shore (LOTS) Test and Evaluation Program, ORI TR No. 1037, 20 October 1976, see pgs. 16-20.

TABLE D.7

TIME TO OFF-LOAD EACH LIGHTER AT RED BEACH

Lighter	Cargo	Total Off-Load Time
LCU 1661	Trailer, utility Truck, $\frac{1}{4}$-ton utility 2 Trailers, $1\frac{1}{2}$-ton cargo 2 Trucks, $2\frac{1}{2}$-ton cargo	12 min.
LCM8 ACU2-18	14 Rolls concertina wire	45 min.
LCM8 ACU2-18	9 Rolls concertina wire	17 min.
LCM8 8592	12 Pallets sandbags 10 Rolls concertina wire	1 hr 30 min.
LCU 1524	58 Pallets sandbags 33 Pallets barbed wire 24 Pallets metal stakes 7 Rolls concertina wire	4 hr 15 min.
LCM8 ACU2-82	20 Pallets sandbags 5 Pallets metal stakes 1 Pallet barbed wire	56 min.
LCM8 8599	6 Pallets sandbags 3 Pallets metal stakes 1 Pallet barbed wire 2 Pallets, contents unknown	Not Recorded
LCU 1516	62 Pallets C-rations 19 Pallets compressed fuel 11 Pallets sandbags 12 Pallets metal stakes	4 hr 7 min.
LCM8 ACU2-20	18 Pallets C-rations	25 min.

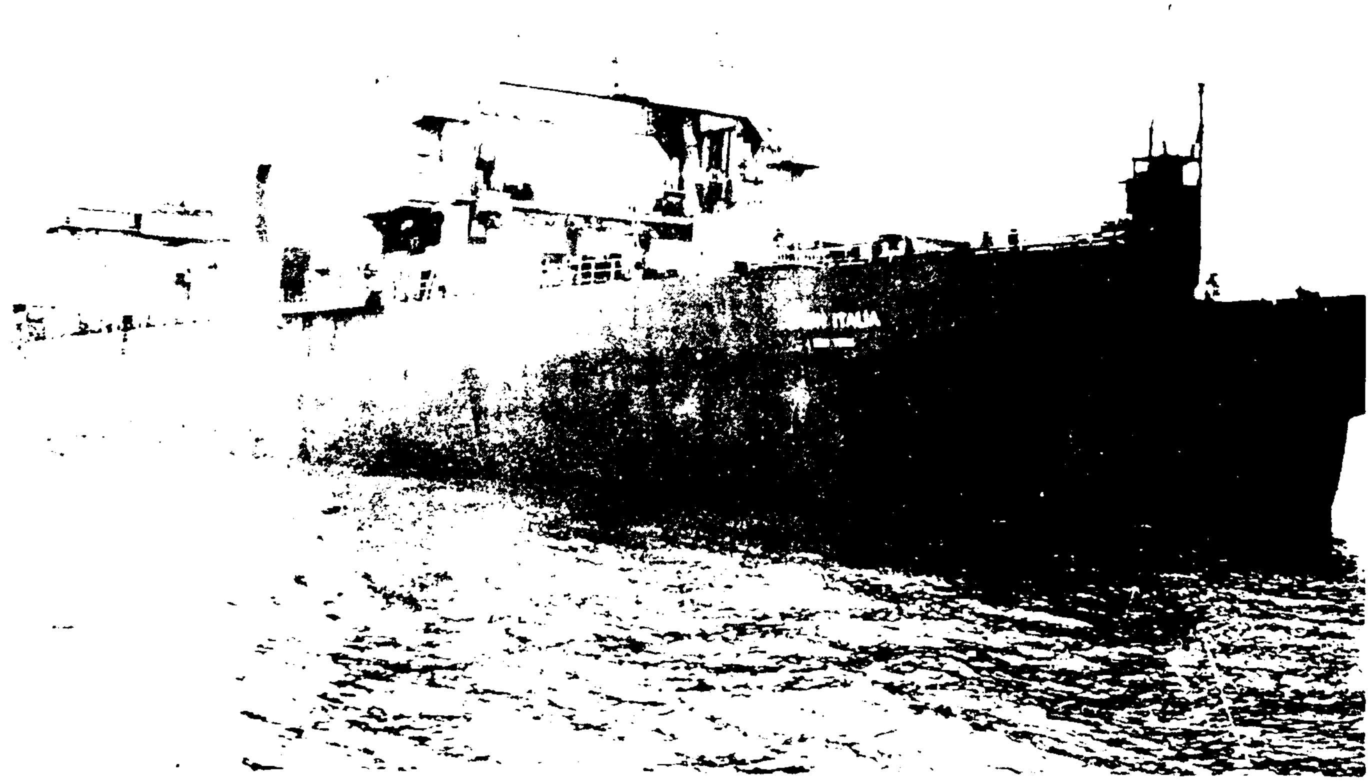
TABLE D.8

LIGHTER-CARGO-TIDAL CONDITIONS AT RED BEACH

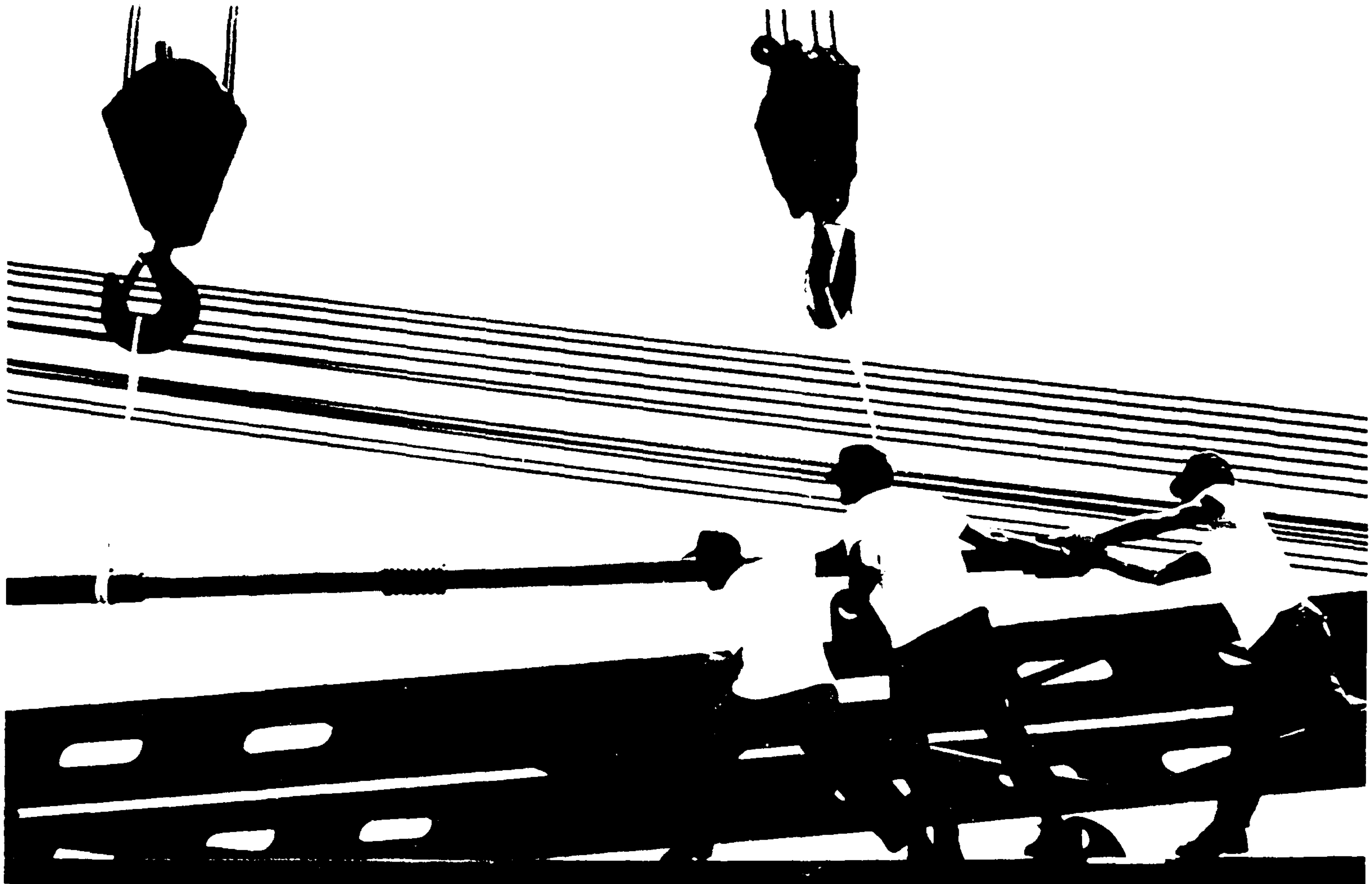
Lighter	Cargo	Aug.-76 Local Date-Time Group First Attempt To Beach	Nearest Tidal Condition At Time of First Lighter Approach	Delay Time After First Approach	Remarks
LCU 1661	6 Vehicles	261540	½ hr after low	45 min.	Off-loaded over causeway
LCM8-18	Concertina	261910	3 hr before high	None	Lightly loaded
LCM8-9	Concertina	262010	2 hr before high	None	Lightly loaded
LCM8-18	Concertina	270010	2 hr after high	None	Lightly loaded
LCM8-8592	Sandbags and Concertina	270155	2 hr before low	43 min.	Lightly loaded
LCU 1524	122 Pallets	270710	3 hr after low	18 min.	Had a wet ramp
LCM8-82	36 Pallets	270755	2 hr before high	None	Lightly loaded
LCM8-8599	11 Pallets	271109	½ hr after high	15 min.	Lightly loaded
LCU 1561	103 Pallets	271700	1 hr before low	80 min.	Had a wet ramp
LCM8-20	18 Pallets	271725	½ hr before low	66 min.	Payload estimated at 12 short tons

APPENDIX E

PICTORIAL SUMMARY OF LOTS LASH PRETEST

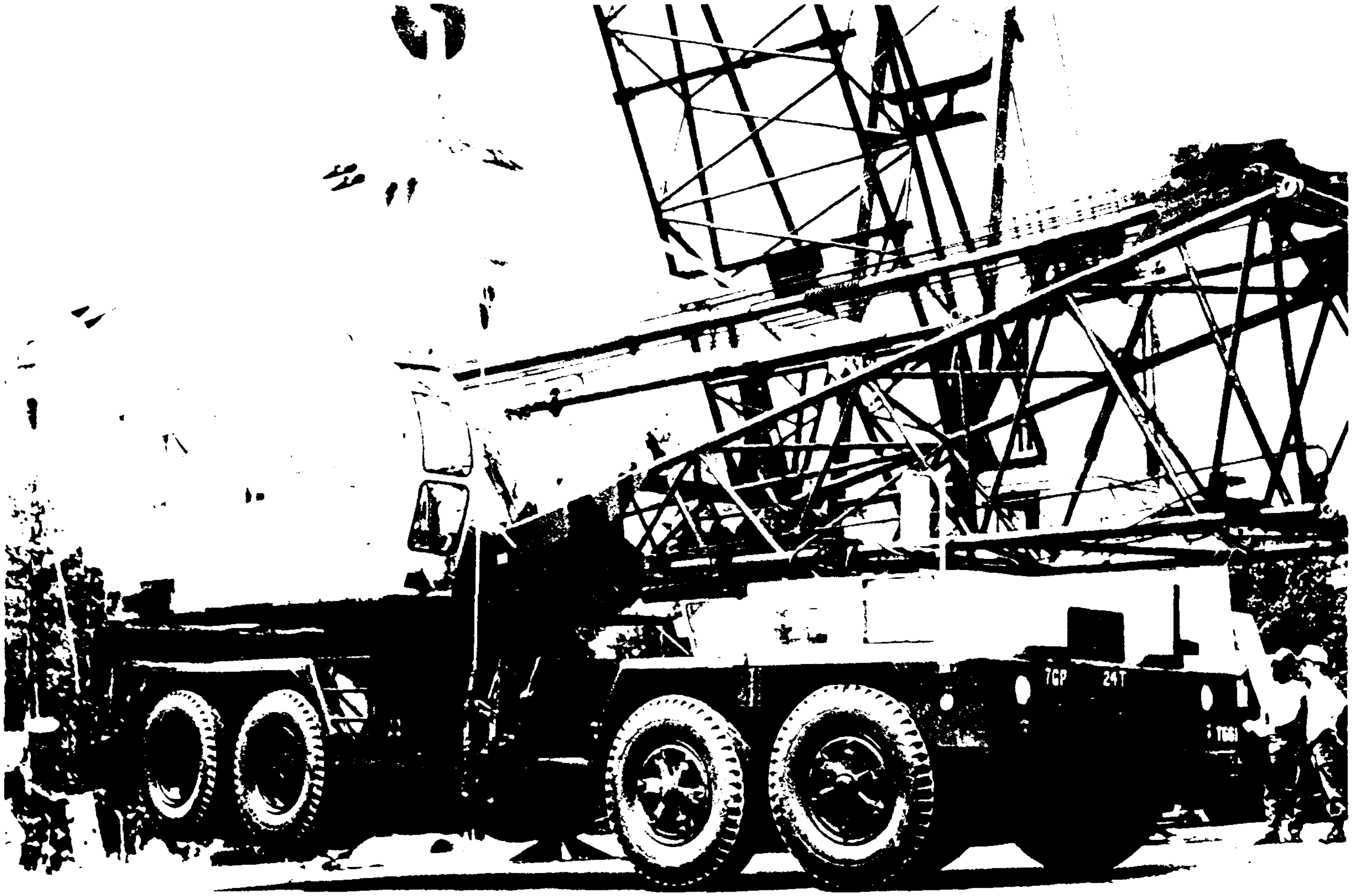


[illegible]. LASH ITALIA AT ANCHOR. The S.S. LASH ITALIA, chartered August 2[illegible], 19[illegible], was the first LASH ship to be solely dedicated to a military exercise. LASH ITALIA embarked in port and discharged at anchor large LOTS equipment items using an [illegible] lift Gear also operationally tested for the first time. The LASH ship pretest was the second in a series conducted under the Joint LOTS Test and Evaluation Program.



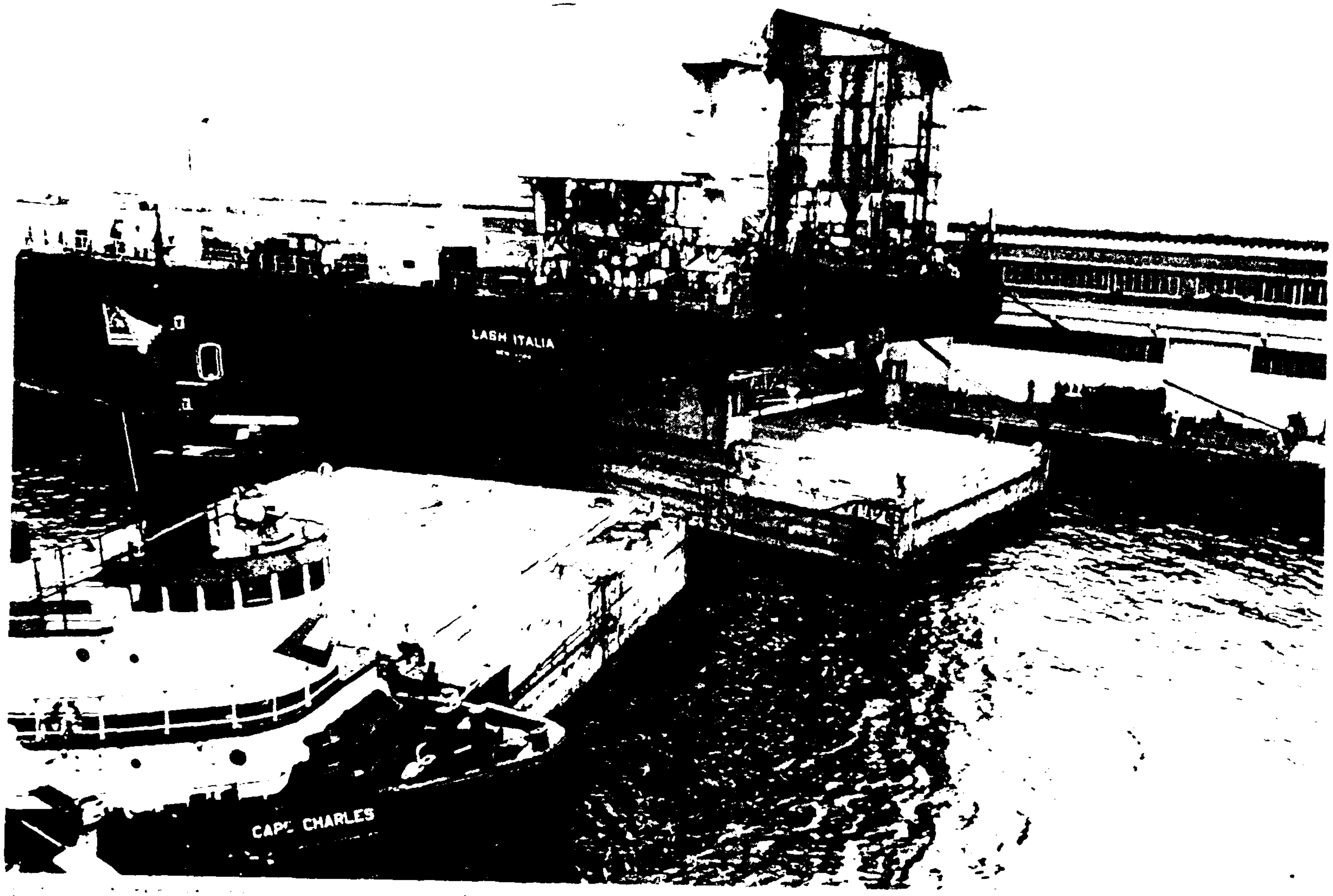
E.2 CRANE DISASSEMBLY. In order to evaluate deployment feasibility of the [illegible]-ton crane, the Army's P&H 6250 crane was one of the priority items to be loaded. Because the crane had to be lightered to shore in the objective area by a landing craft (an [illegible]) also embarked on the [illegible], it was necessary to disassemble the crane into its administrative configuration.

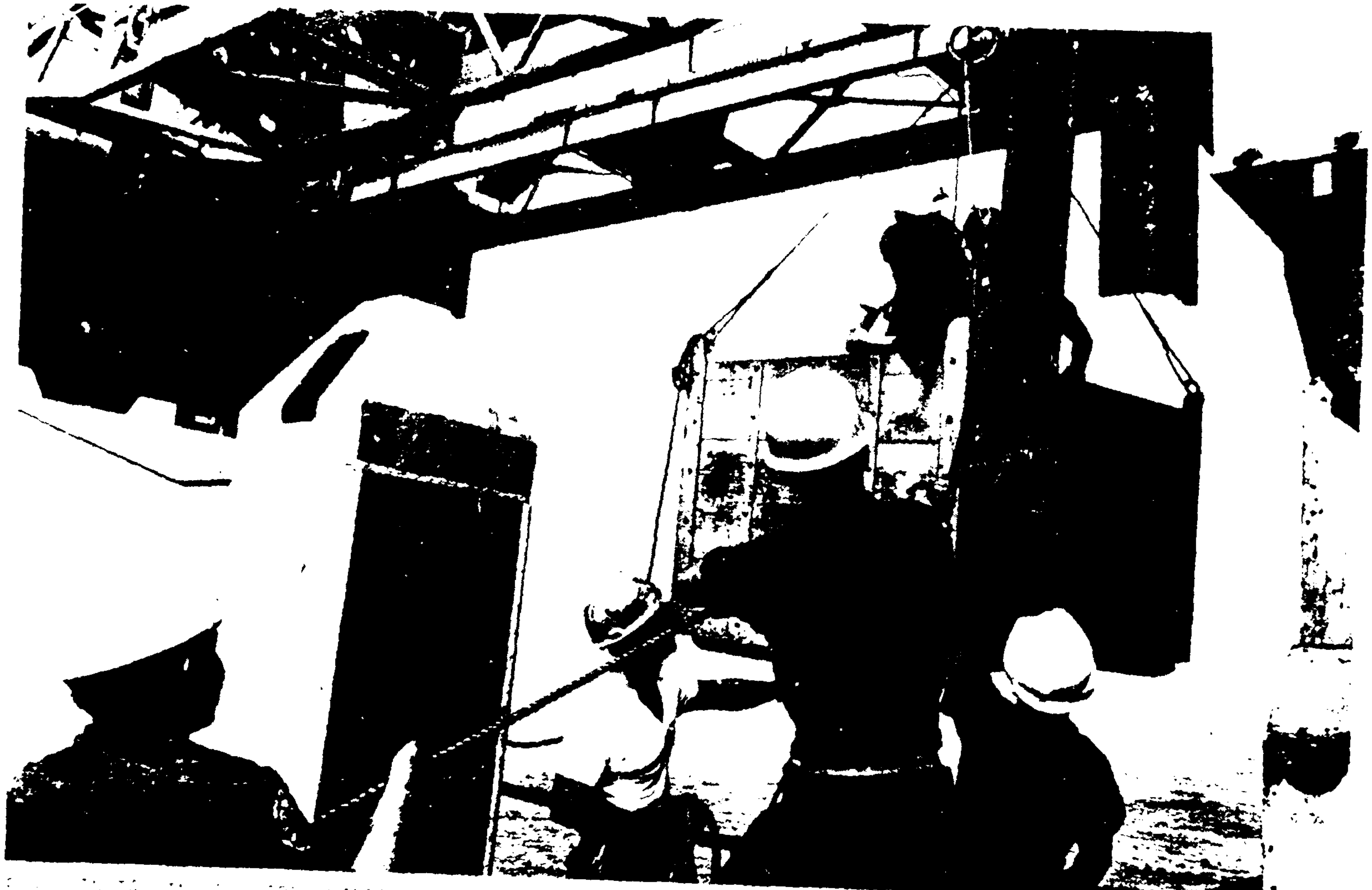
E.3. NEW SLING TESTED. Prior to the LOTS pretest it was necessary to check-test a new strongback for lifting the container cranes. Above, the carrier for the Army's 300-ton capacity crane is hoisted by the Army's 140-ton container crane. The crane upper, although heavier, is shorter—even when mobile-loaded on an M747 trailer—and relatively easy to off-load into an LCM8. Therefore, the crane upper was not part of the pretest.



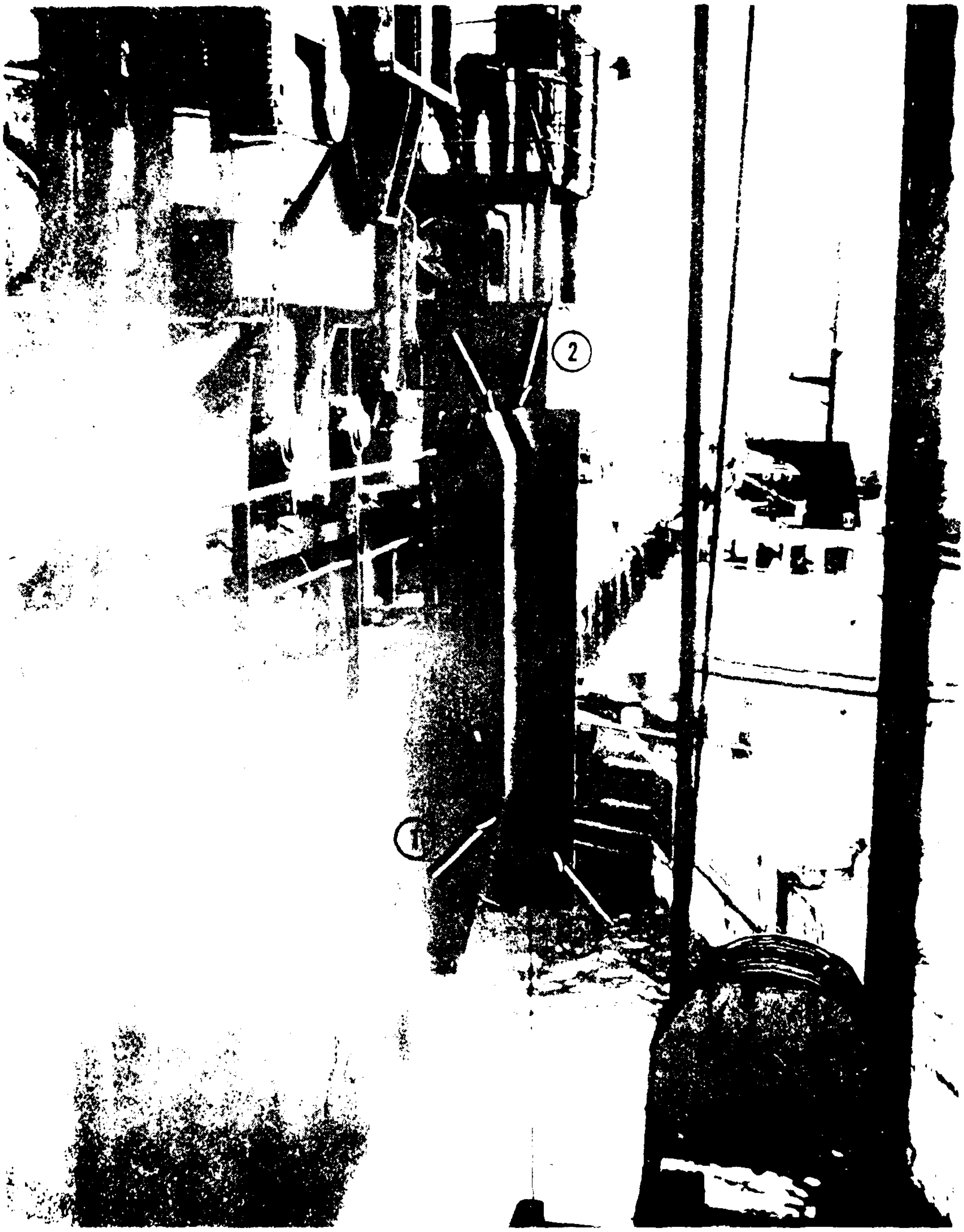
E.4. NEW SLING TESTED ON 14 [illegible] CRANE. In the first [illegible] pretest the 140-ton crane [illegible] aboard a conventional breakbulk ship [illegible] of a faulty sling design. The new design, [illegible] tested above, was [illegible] plane.

E.5. SPECIAL RIGGING GEAR USED. Because of the exceptionally heavy test equipment to be loaded, very large pins and nuts were required for attaching shackles and chains to the LCM lift pads.

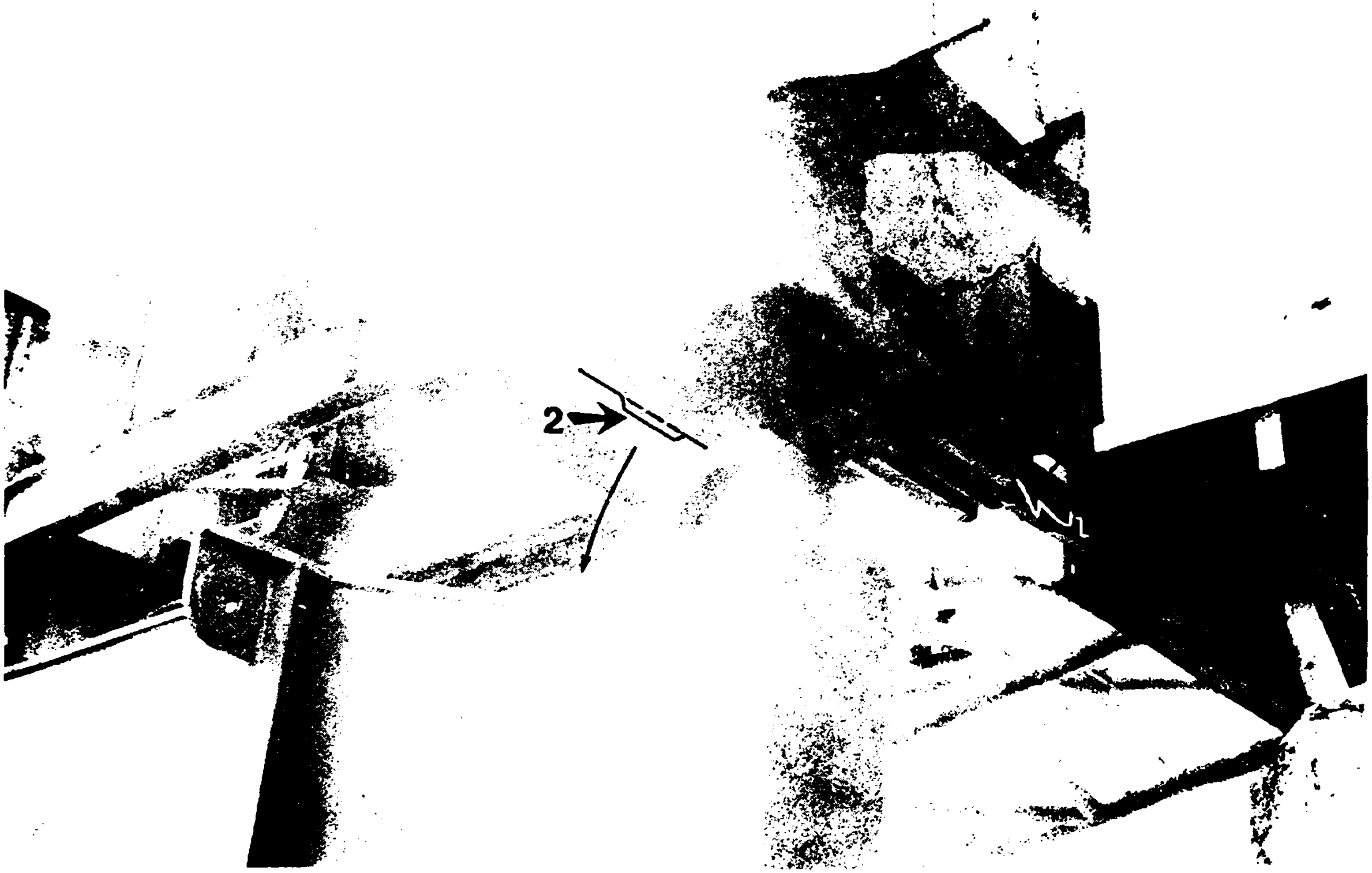

LASH ITALIA
CAPE CHARLES



[illegible] The [illegible]ification necessary was the shifting [illegible] of the [illegible] frame [illegible]



[illegible] READY. Arrow one above shows the gantry crane [illegible] in its [illegible] position. Arrow two shows the rearward [illegible] cargo loading operations. The aft position is neces- [illegible] proper alignment of an [illegible]'s center of gravity under the [illegible]



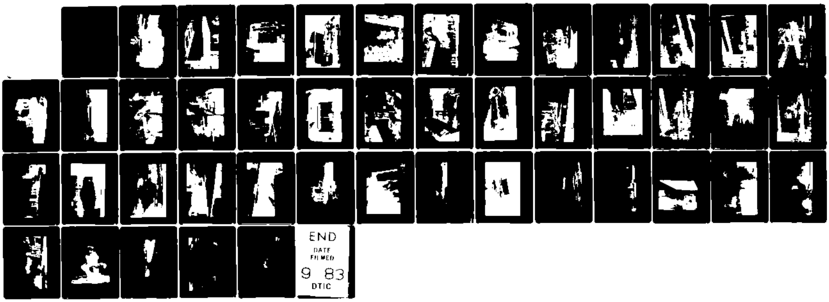
E.10. CRANE ATTEMPTS TO ENGAGE LCM8 LIFT BEAM. Gathering cones on the lighter gantry crane attempted to engage the LCM8 lifting beam. The cones (port and starboard— starboard shown) could not be seated far enough down on the LCM8 lift beam attachment points for the locking bar (see arrow one) to engage. A lip on the cone (see arrow two) prevented the seating.

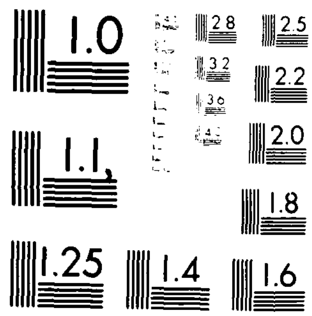
E.11a and E.11b. GATHERING CONES BEFORE AND AFTER MODIFICATION. Photo at the top shows the cone before the lip was cut off and the photo at the bottom shows the results after a cut was made. The decision to cut them and the subsequent modifications to each of the four cones delayed loading for approximately [illegible] hours.

E.12. ASSEMBLY OF THE CAUSEWAY LIFT FRAME. The first special lift to be made, a [illegible] x 15 causeway with [illegible].5 short tons of weight on it, required use of two LCM lift beams and a lifting frame, approximately 32 ft long, to extend the reach of the lighter gantry crane to points over the causeway's center of gravity. Above, [illegible]

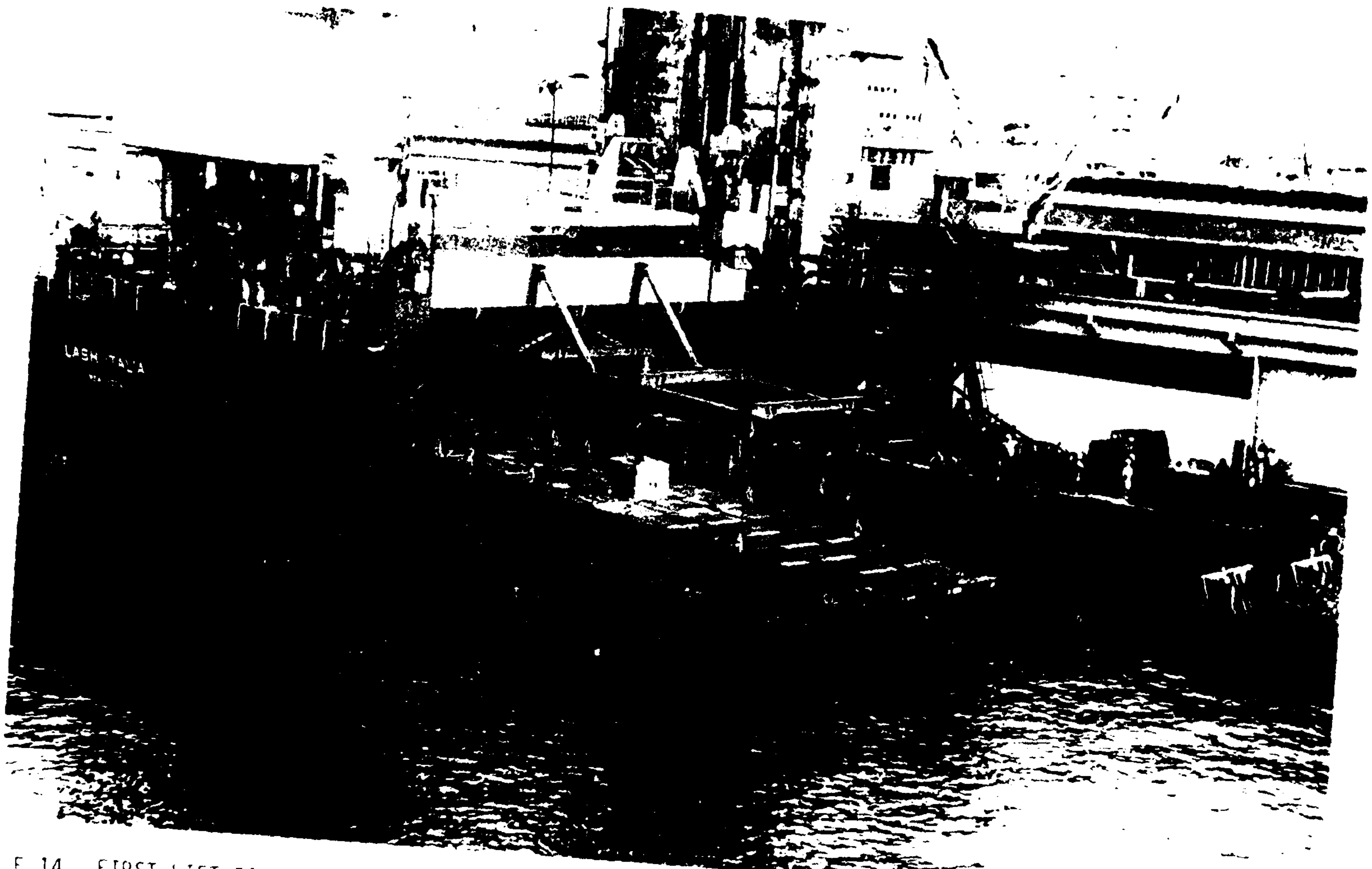
AD-A131 701 LASH SHIP PRETEST RESULTS OF THE JOINT LOGISTICS-OVER-THE-SHORE (LOTS) TE..(U) OPERATIONS RESEARCH INC SILVER SPRING MD H CASEY ET AL. 07 MAR 77 2/2

UNCLASSIFIED ORI-TR-1121 MDA903-75-C-0016 F/G 13/10 NL

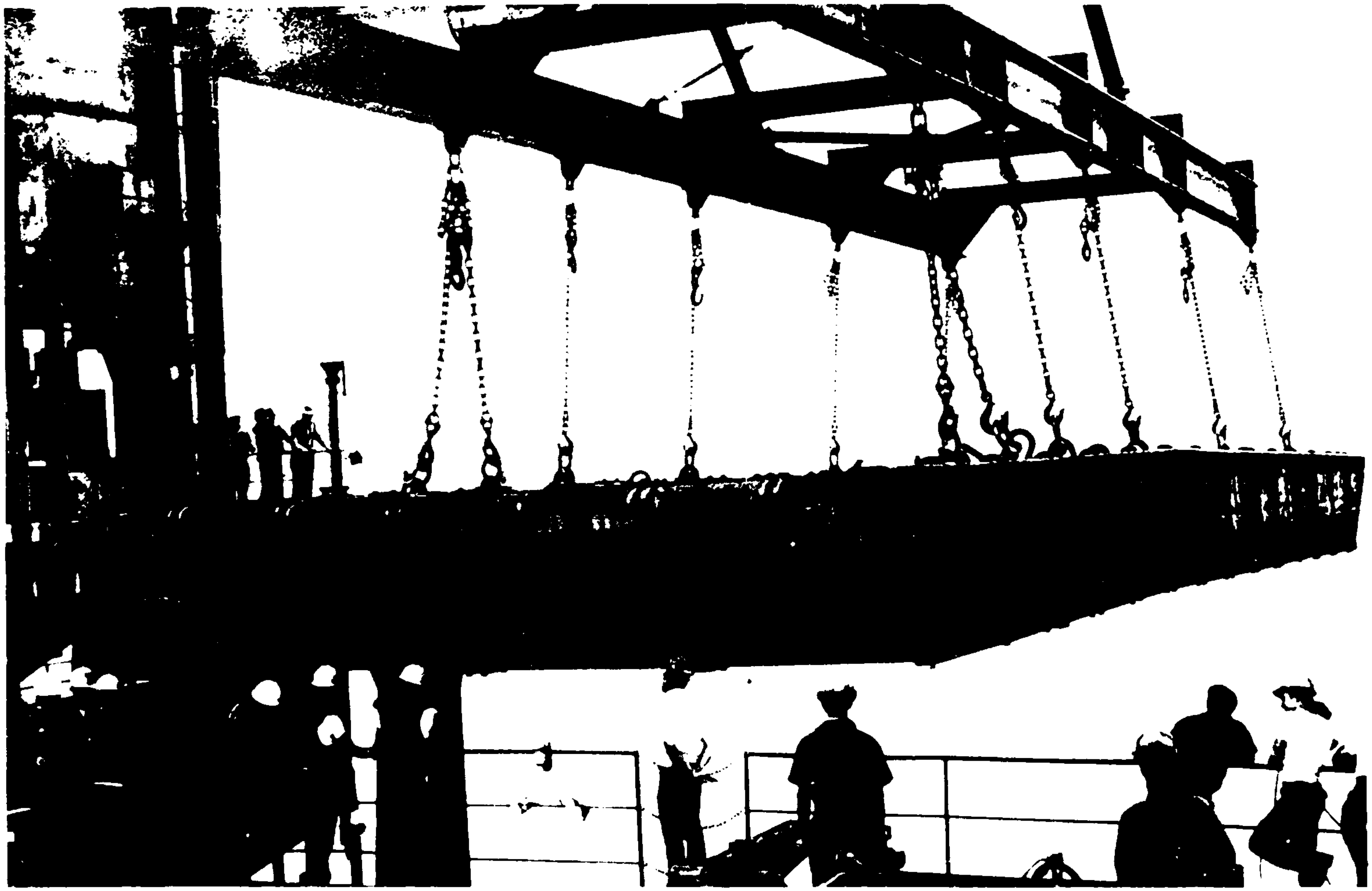




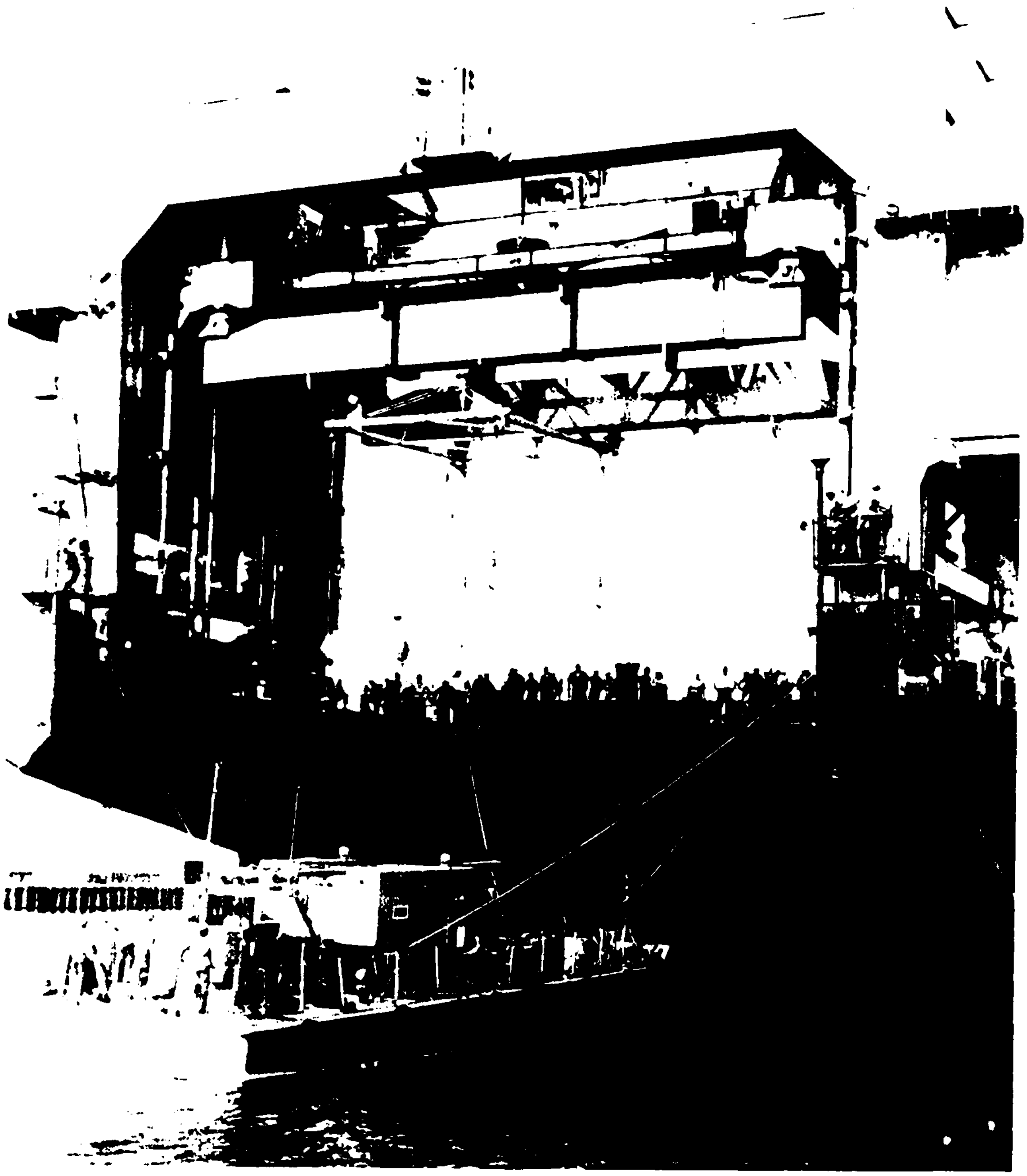
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A



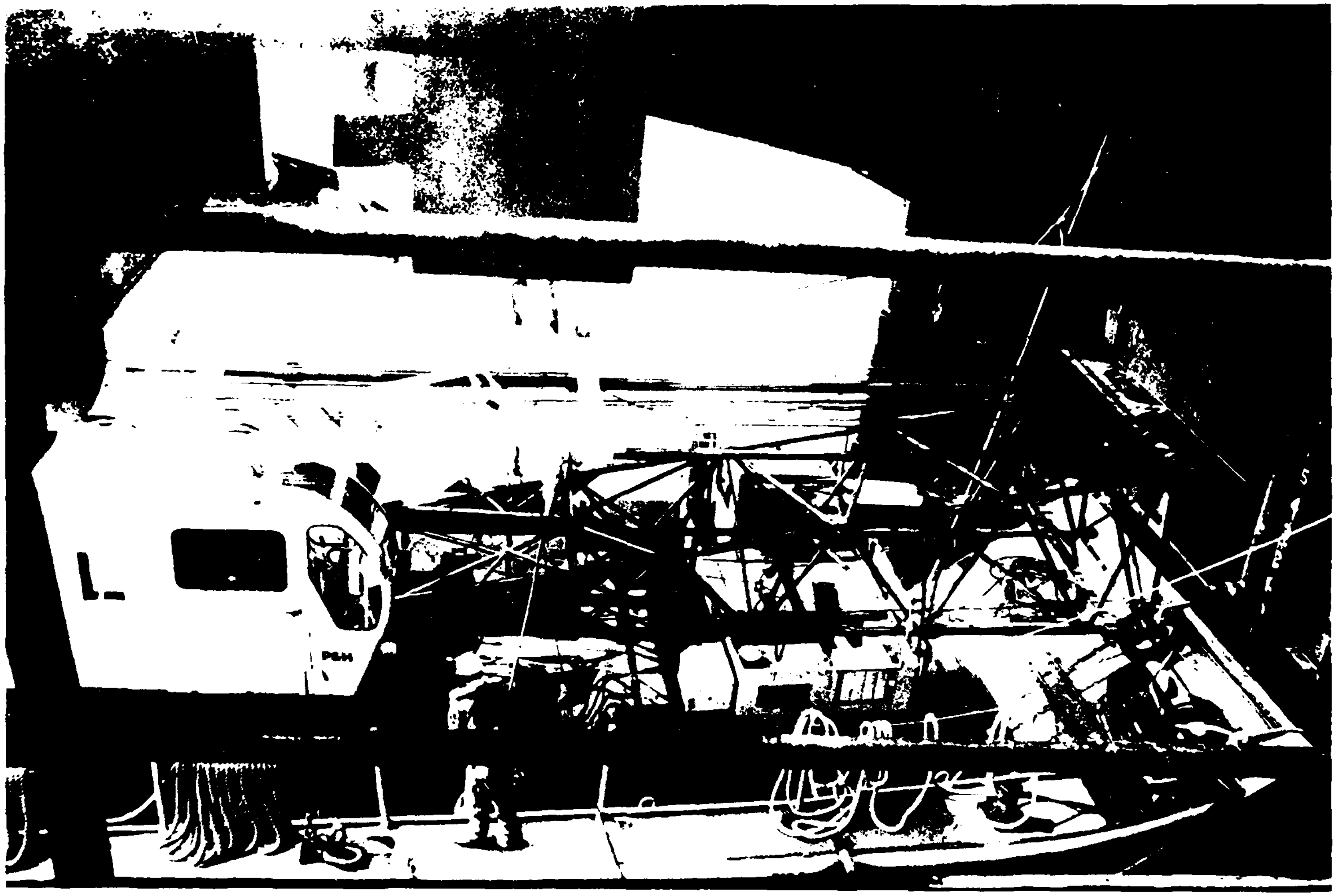
E.14. FIRST LIFT FAILED. The 3 x 15 causeway with 87.5 short tons aboard to simulate a warping tug could not be safely hoisted by the lifting frame. In a second try, with all weights removed except for a 7-ton block as shown, the 3 x 15 causeway was hoisted aboard ship. The lift beam was then certified by the American Bureau of Shipping for lifting causeway sections.



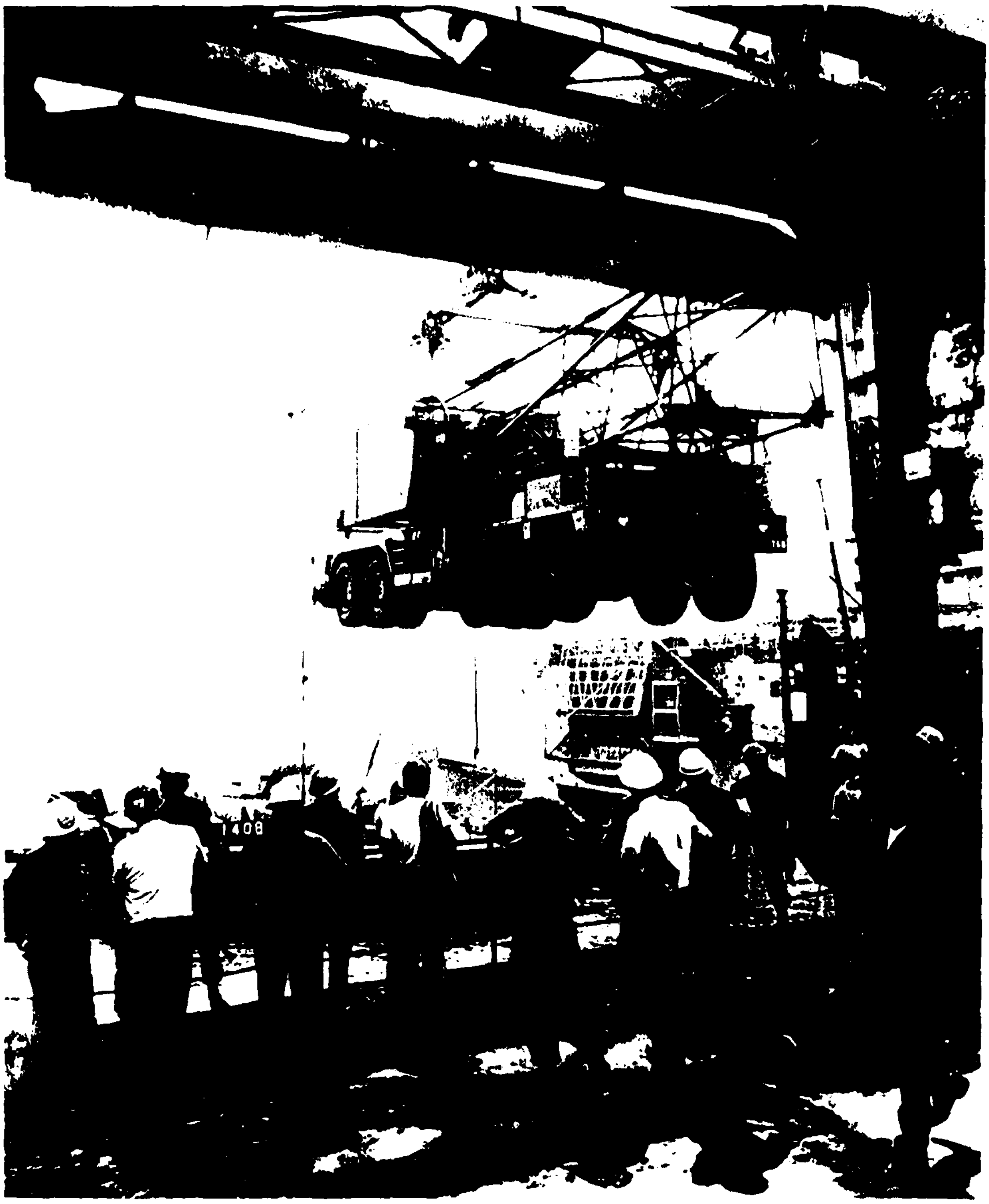
E.15. CAUSEWAY OFF-LOADING. Later, when the LASH ITALIA had been fully loaded, the ship moved to an anchorage off Green Beach, Ft. Story. After more than 7 hr spent trying to assembly the causeway lift frame to the LCM8 lift beam, the 3 x 15 causeway was finally off-loaded in about 49 minutes. Disassembly of the device required about 80 minutes. A new method of attaching the causeway lift frame has subsequently been adopted.



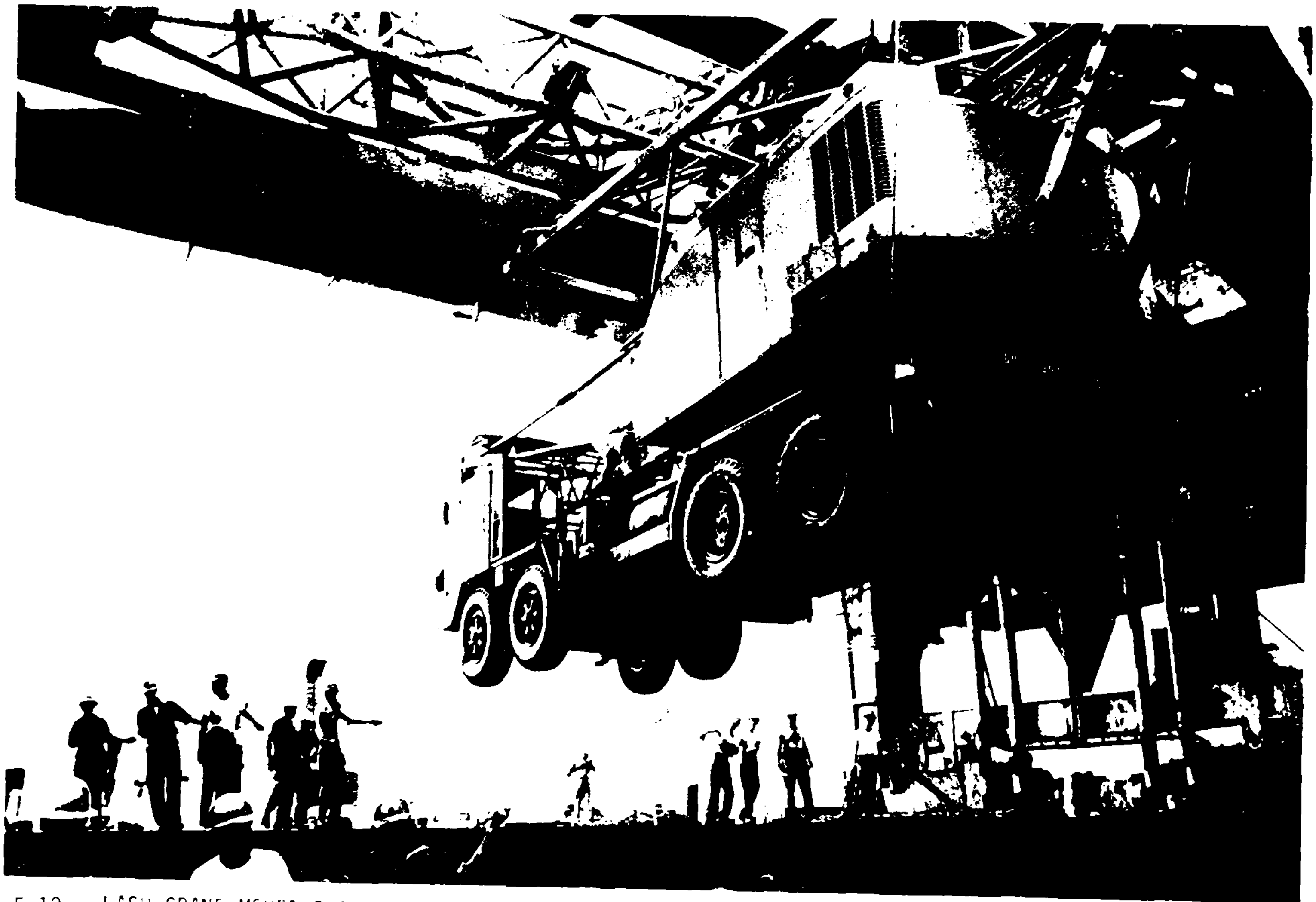
E.16. 140-TON CRANE READY FOR LOADING. The 140-ton crane, which had not yet been successfully loaded aboard any ship, was staged for lifting in its tactically disassembled configuration. Attachment of the strongback to the LCM8 lift beam required about 29 minutes.



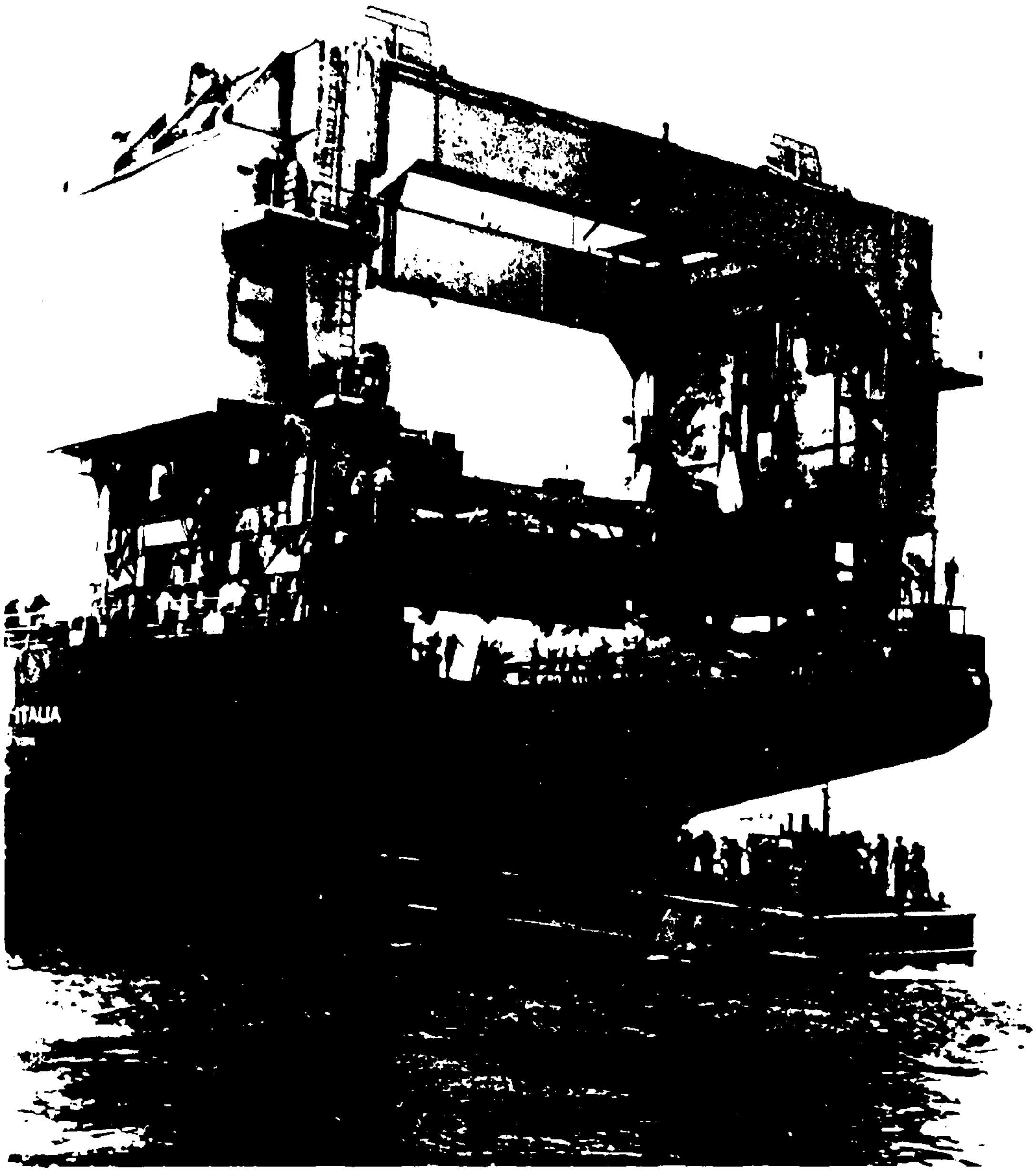
E.17. CLEARANCES IMPORTANT. The 47-short ton weight of the 140-ton capacity crane was hardly a challenge to the 500-short ton lifting capacity of the LASH lighter gantry crane. However, the estimated 4-foot clearance between the 140-ton crane's boom base and the transom of the ship (at right above) had to be watched to ensure no damage to the boom would result from pendulation.



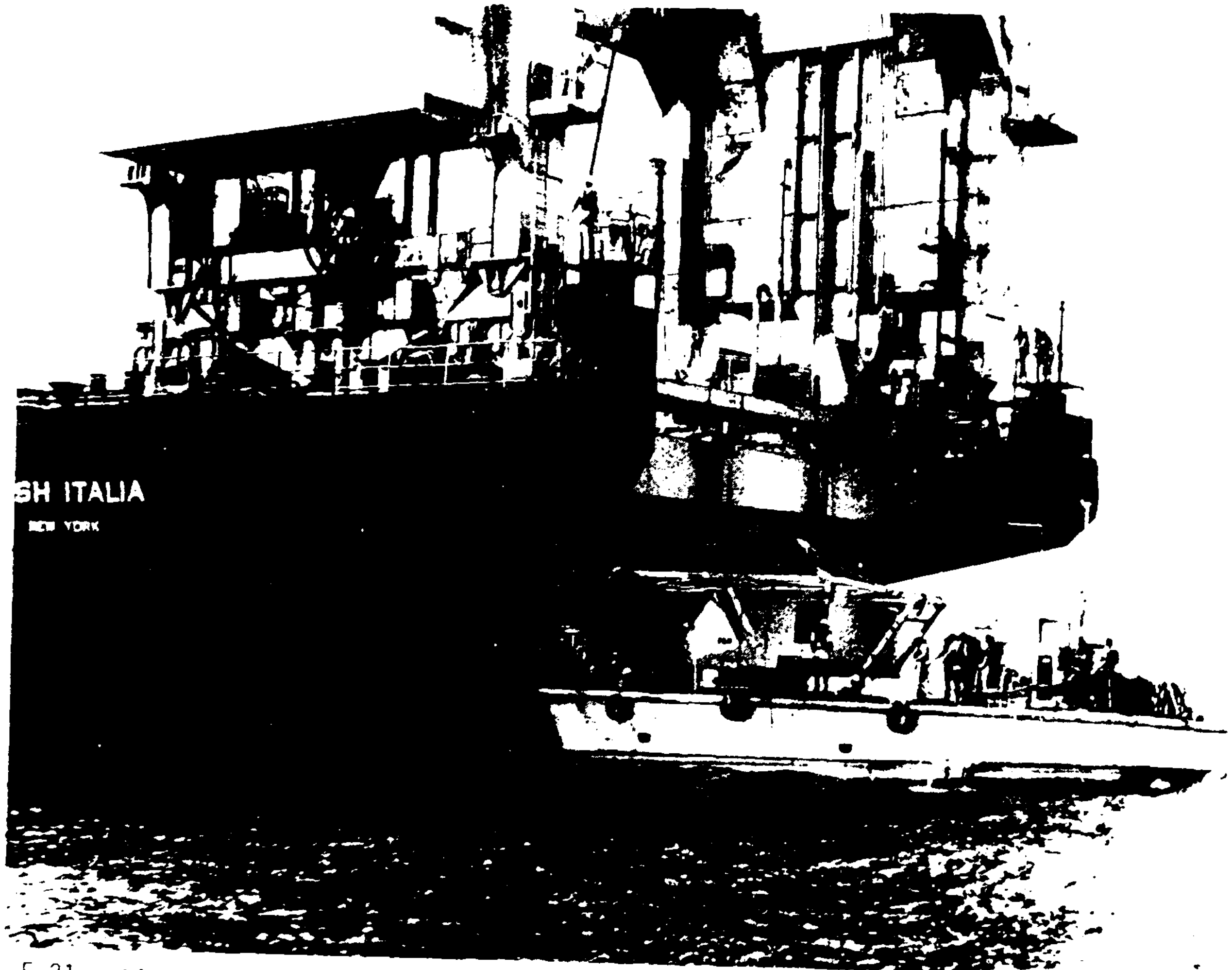
F.1?. SAFELY HOISTED. The newly designed and fabricated crane sling worked satisfactorily, as the Army's 140-ton crane was loaded aboard ship for the first time. It was also the first time a LASH gantry crane had ever loaded a military vehicle.



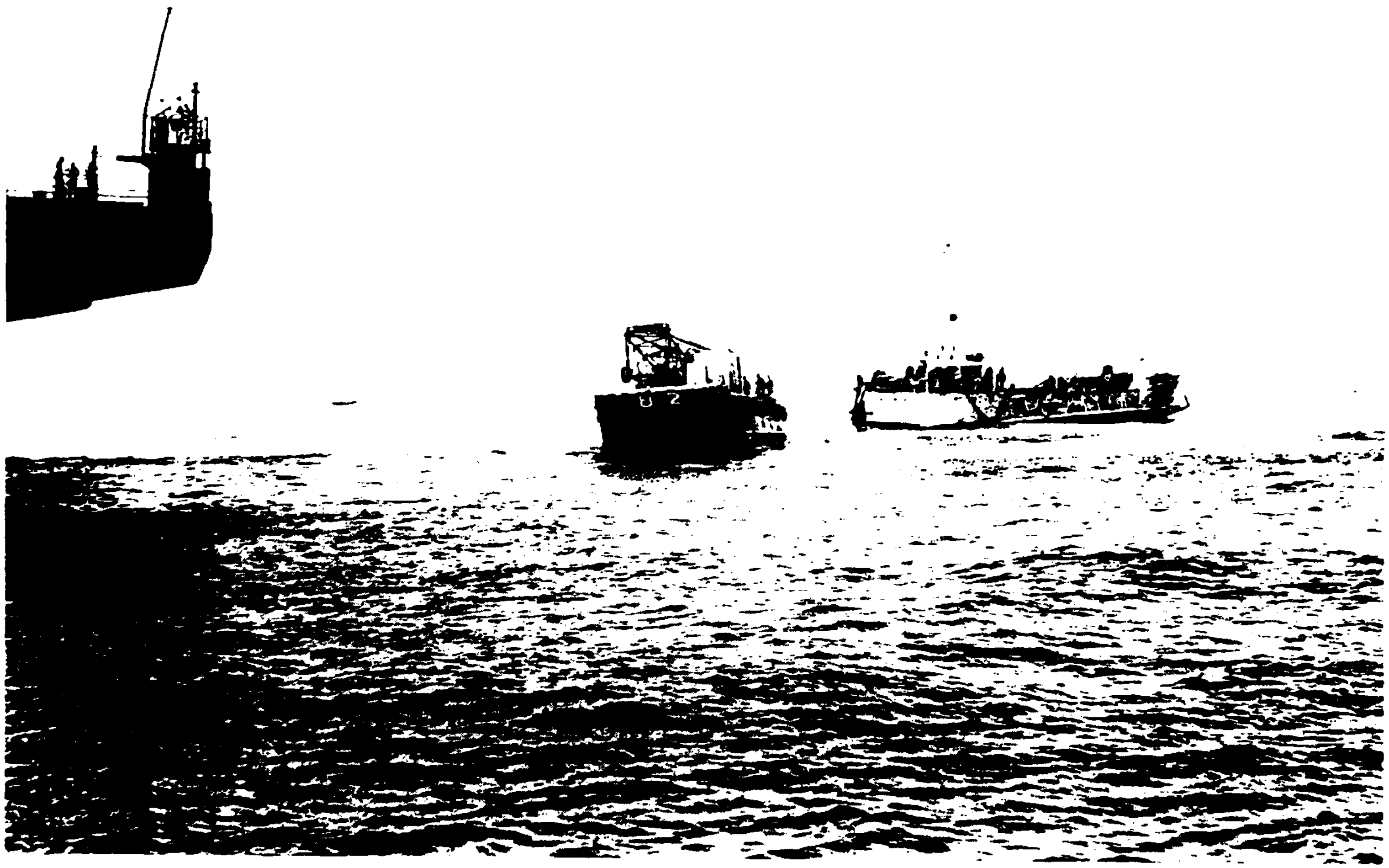
E.19. LASH CRANE MOVED SLOWLY. Once the LASH gantry crane had fully hoisted the Army's 140-ton crane, it moved slowly over the deck to limit pendulation. No difficulties were encountered during the loading. The elapsed time for loading was [illegible] minutes once the [illegible] gear was rigged.



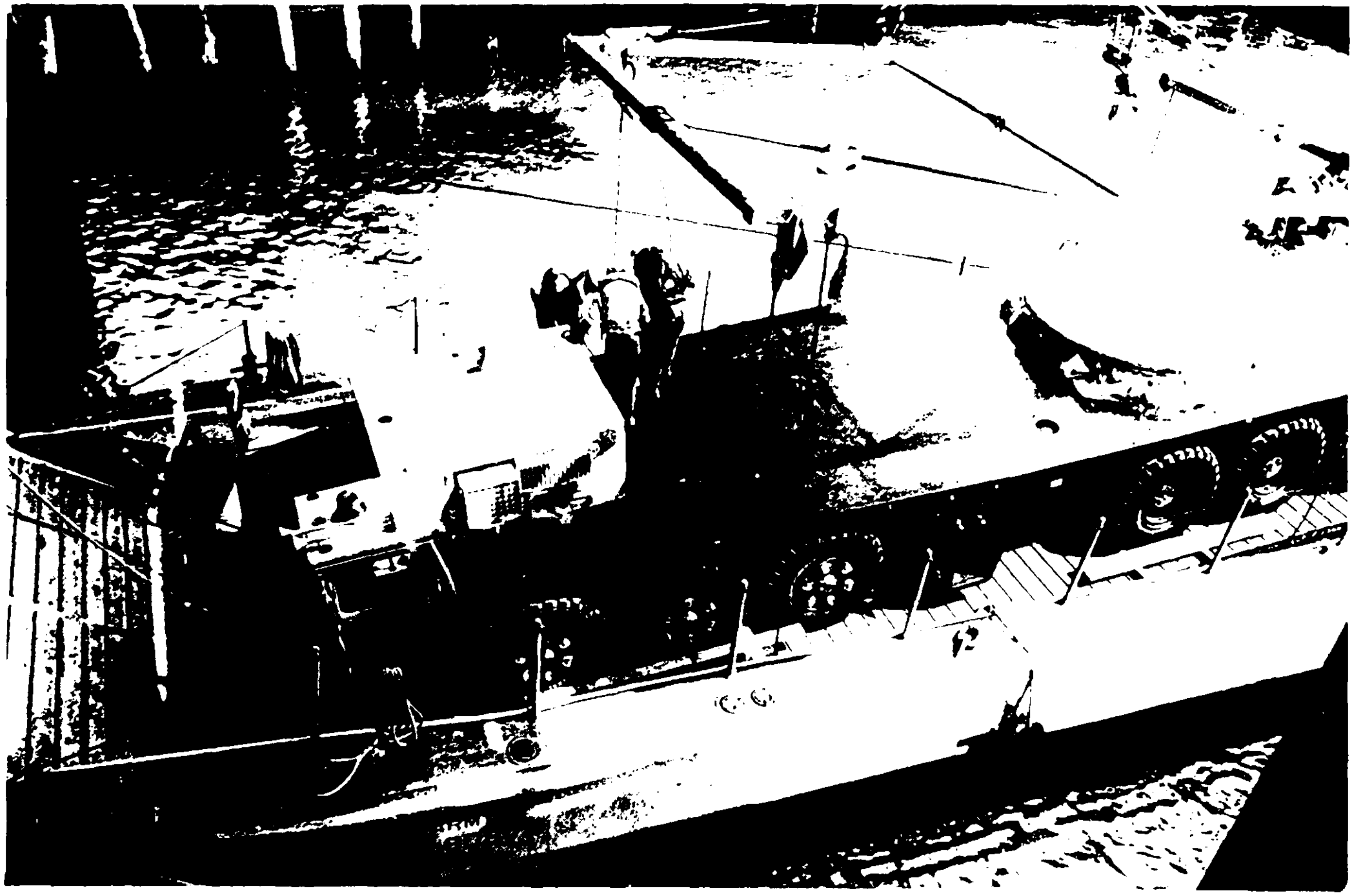
[illegible] OFF-LOADING THE 140-TON CRANE WAS A CRITICAL TEST. The 140-ton crane was off-loaded into an LCM8 while the LASH ITALIA was at anchor in the open [illegible]. Above, an Army LCM8 pushes itself against the stern of the ship to [illegible] position. Snubbing lines from the port and starboard sides of the LASH [illegible] also helped hold the LCM8 steady.



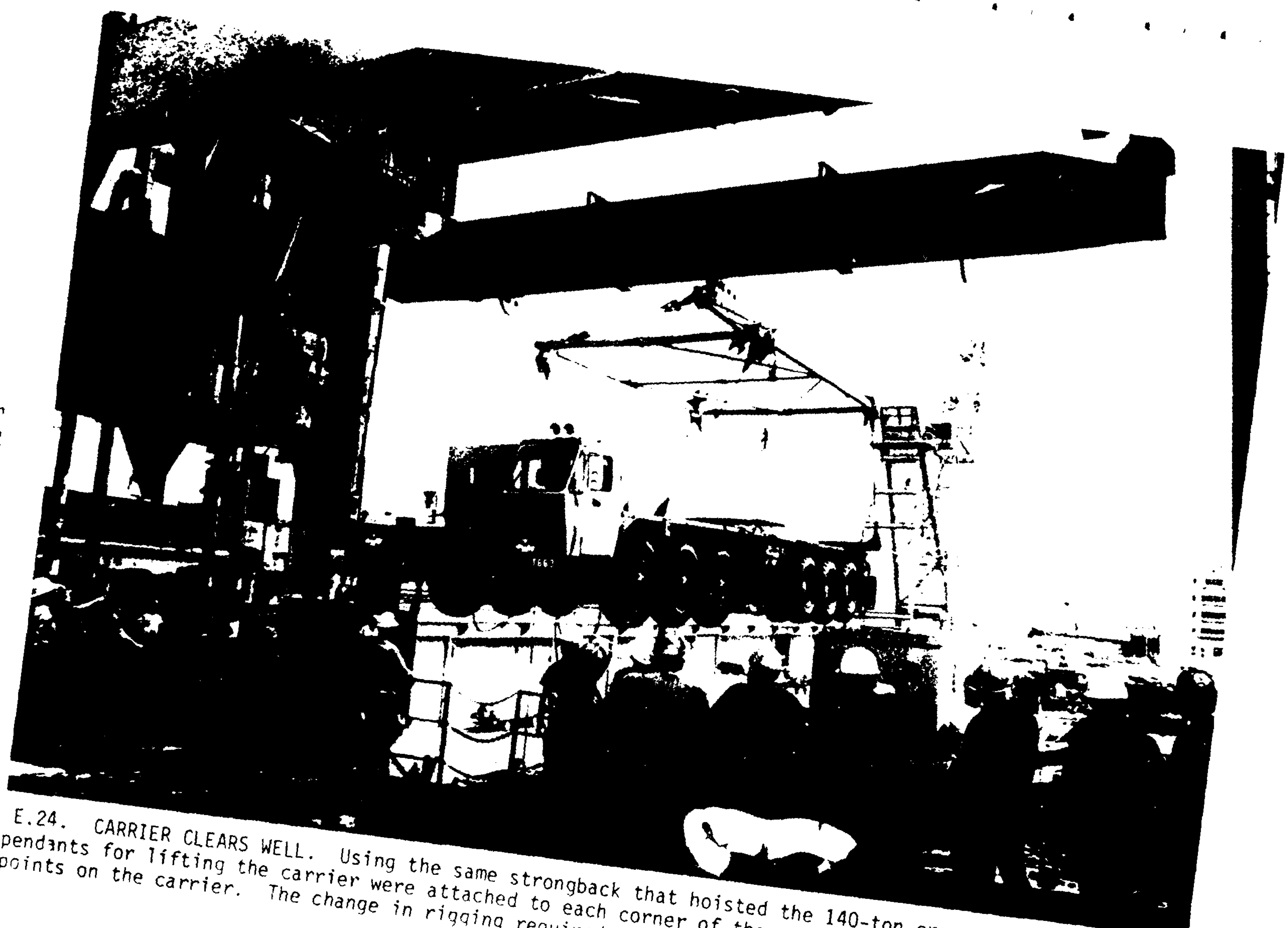
5.21. 140-TON CRANE REPOSITIONED. Once in the LCM8 the 140-ton crane was started and backed further aft in the LCM8 so that the crane rode in a more seaworthy fashion. Lights on the 140-ton crane's upper section were damaged when sea swells caused the 140-ton crane to bang aginst the bottom of the strongback.



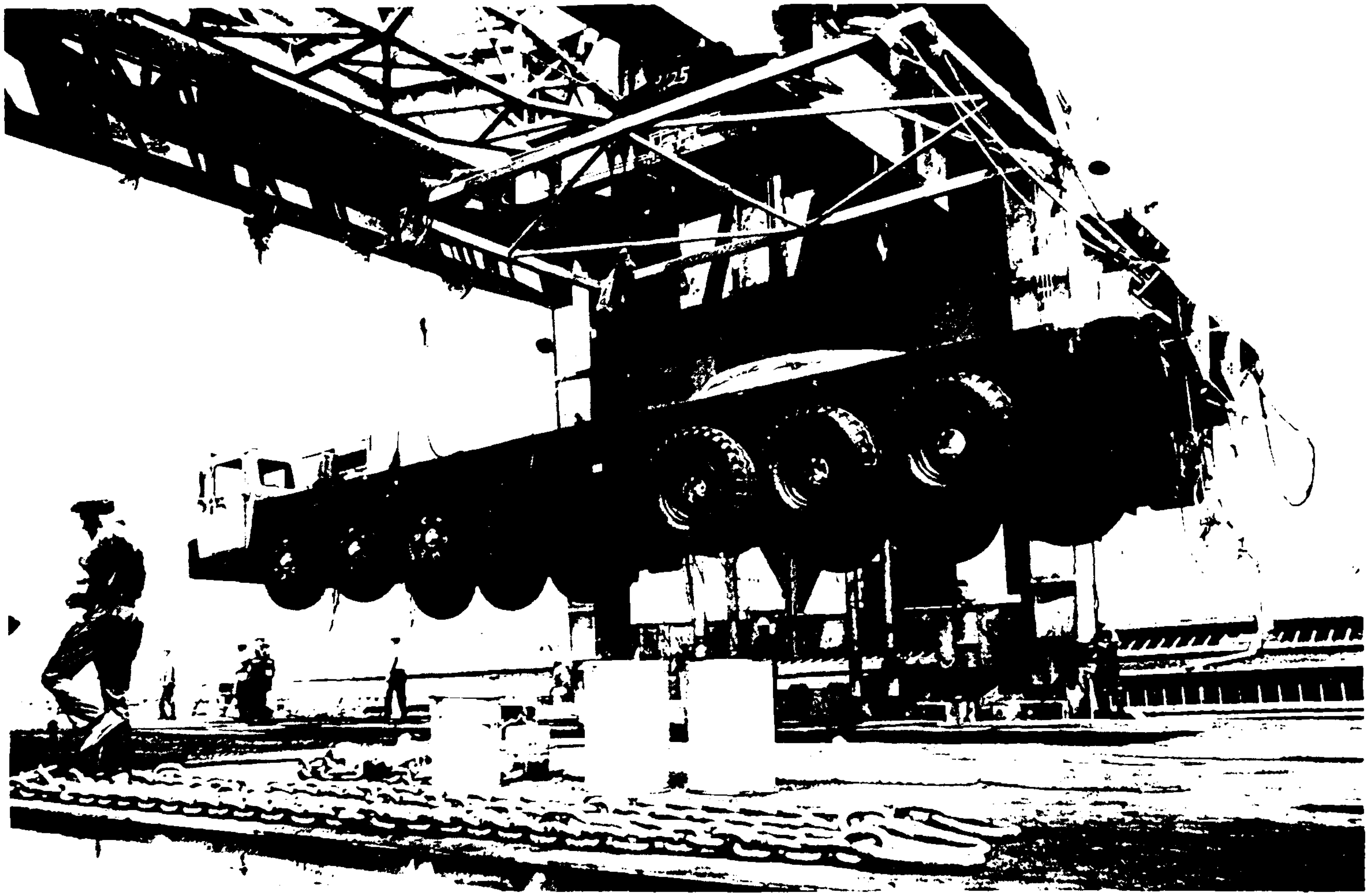
E.22. LCM8 WITH 140-TON CRANE CLEARS WELL. Once the sling was detached the LCM8 departed. Cycle time for the 140-ton crane off-load was 52 minutes.



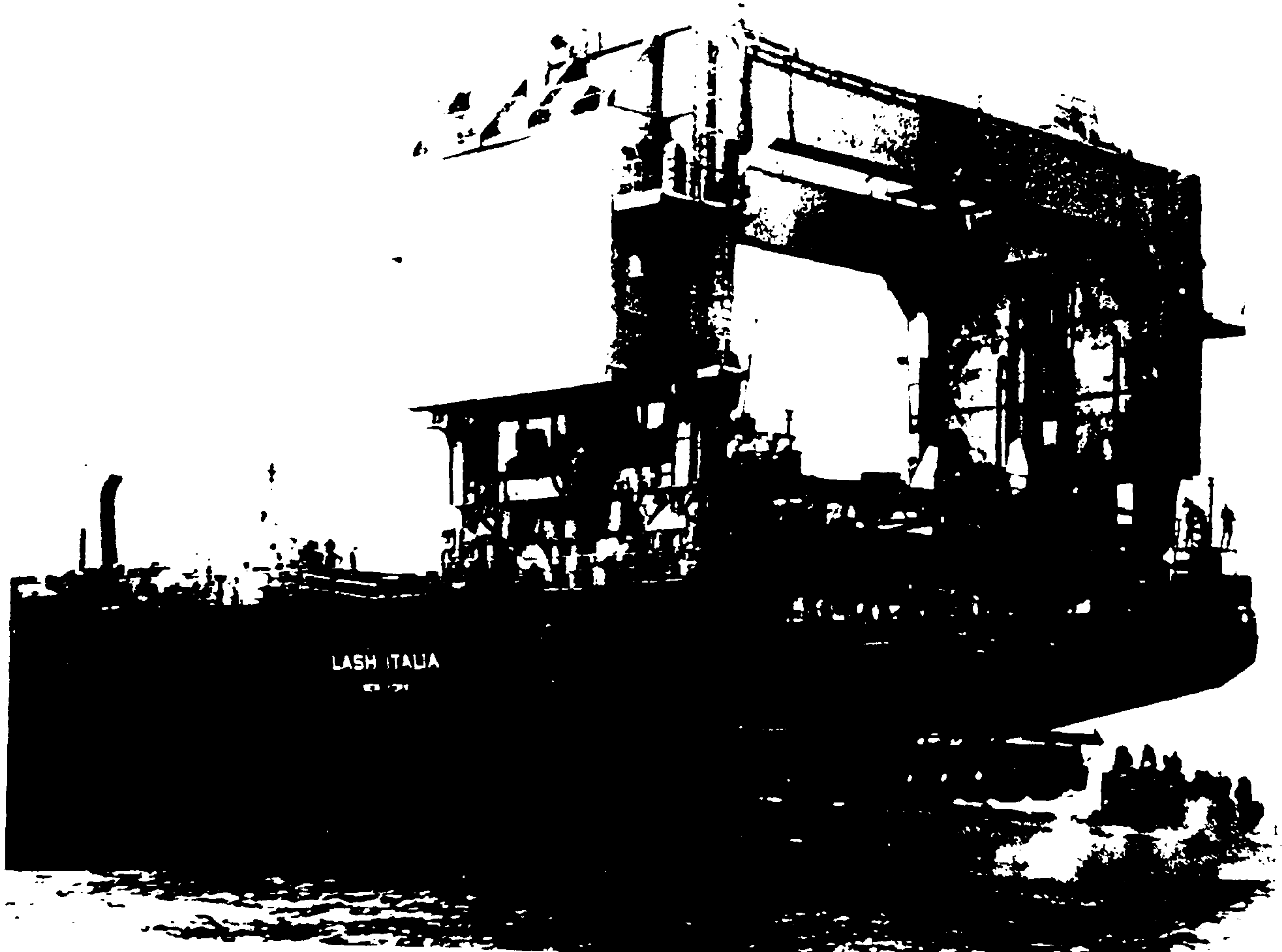
E.23. CARRIER FOR 300-TON CRANE READIED. The carrier for the Army's P&H 6250 crane (300-ton lifting capacity) was one of the selected items of LOTS equipment for the pretest. Because of its length (approximately 47 feet) and the fact that it required inclined well deck ramps to be loaded and carried in an LCM8, the 6250 carrier was a priority item for testing.



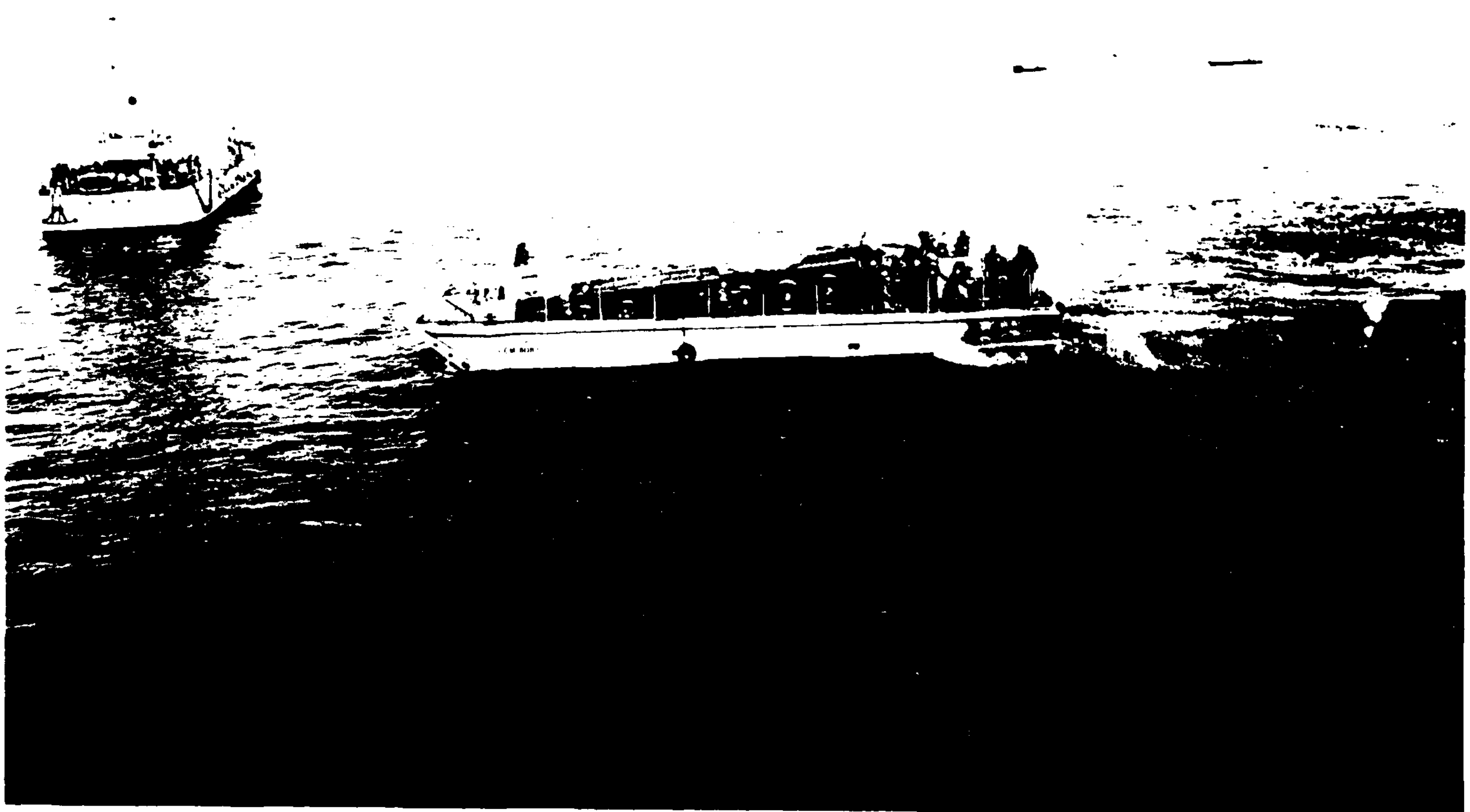
E.24. CARRIER CLEARS WELL. Using the same strongback that hoisted the 140-ton crane, special pendants for lifting the carrier were attached to each corner of the strongback and to special lifting points on the carrier. The change in rigging required about five minutes.



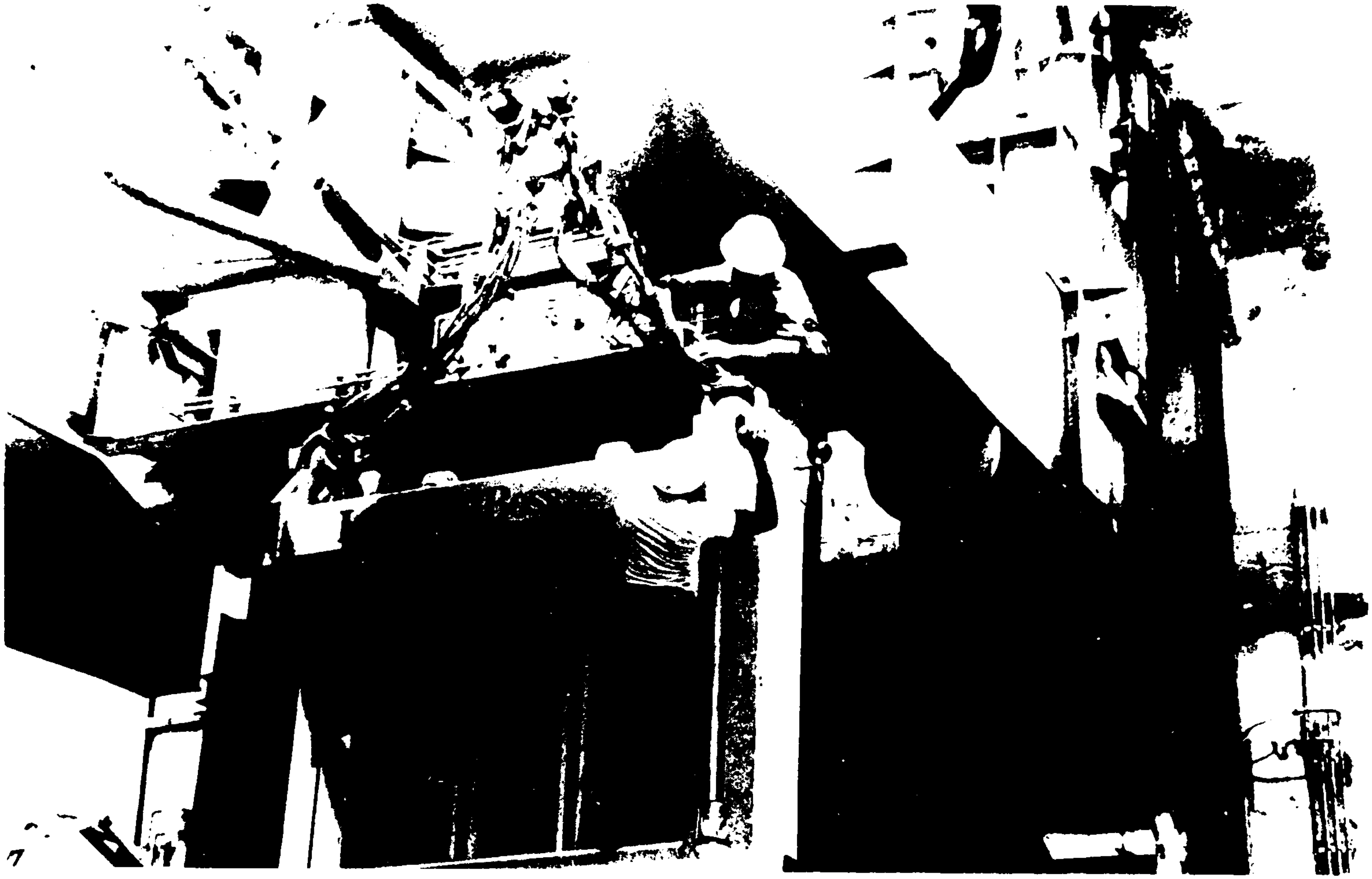
E.25. CARRIER DECK CLEARANCE ADEQUATE. The carrier had more than enough clearance over the hatch squares, as shown above. The elapsed time for loading was 78 minutes, including rigging changes. The upper section of the crane, mobile-loaded on an M747, was considered a less difficult lift and, therefore, was not included in the pretest.



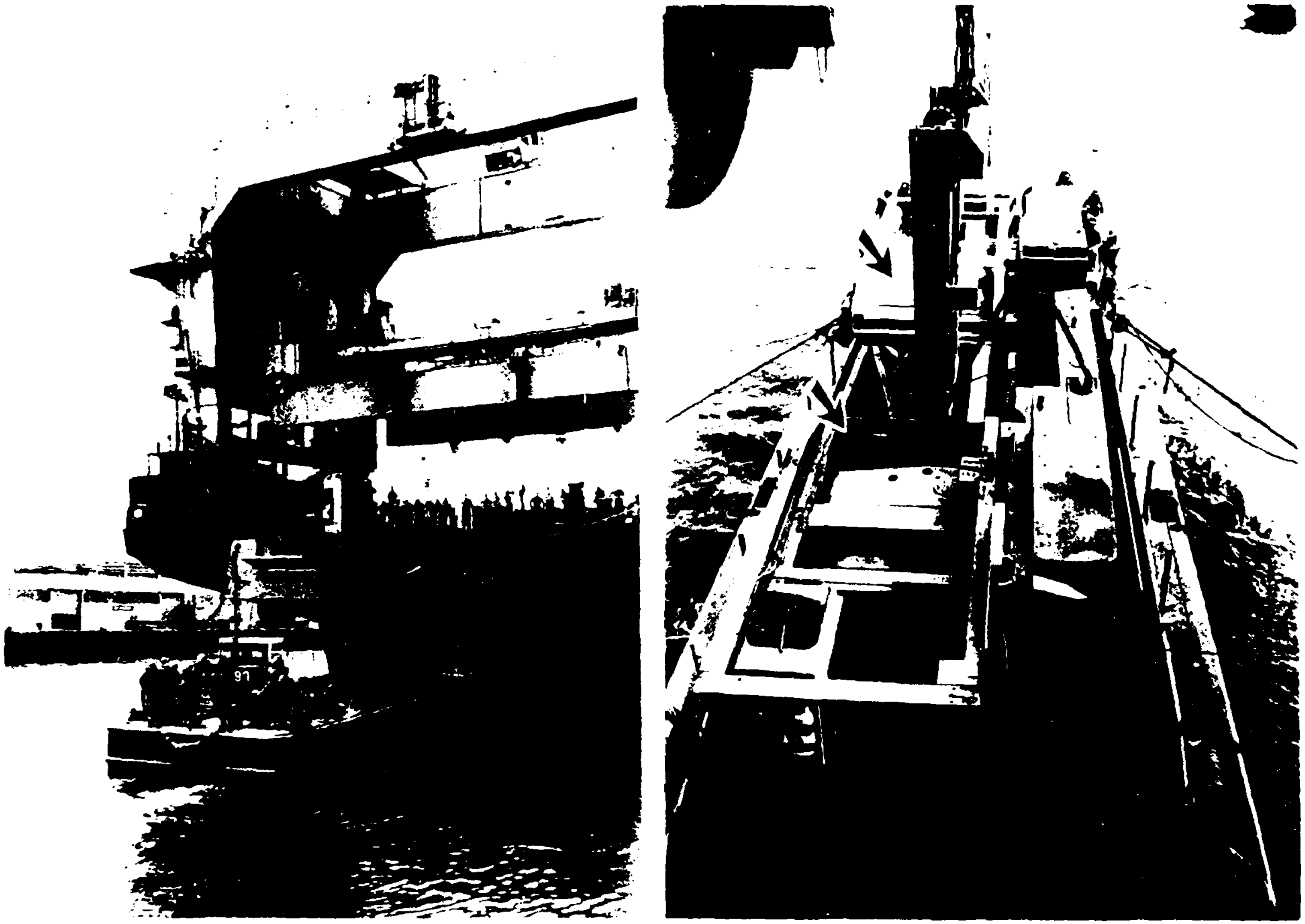
E.26. CARRIER OFF-LOADED IN A SEAWAY. Upon arrival at the anchorage off Green Beach the carrier was off-loaded into an LCM8 that also had been embarked aboard the LASH ITALIA. Cycle time for unloading the carrier, including rigging, was 46 minutes.



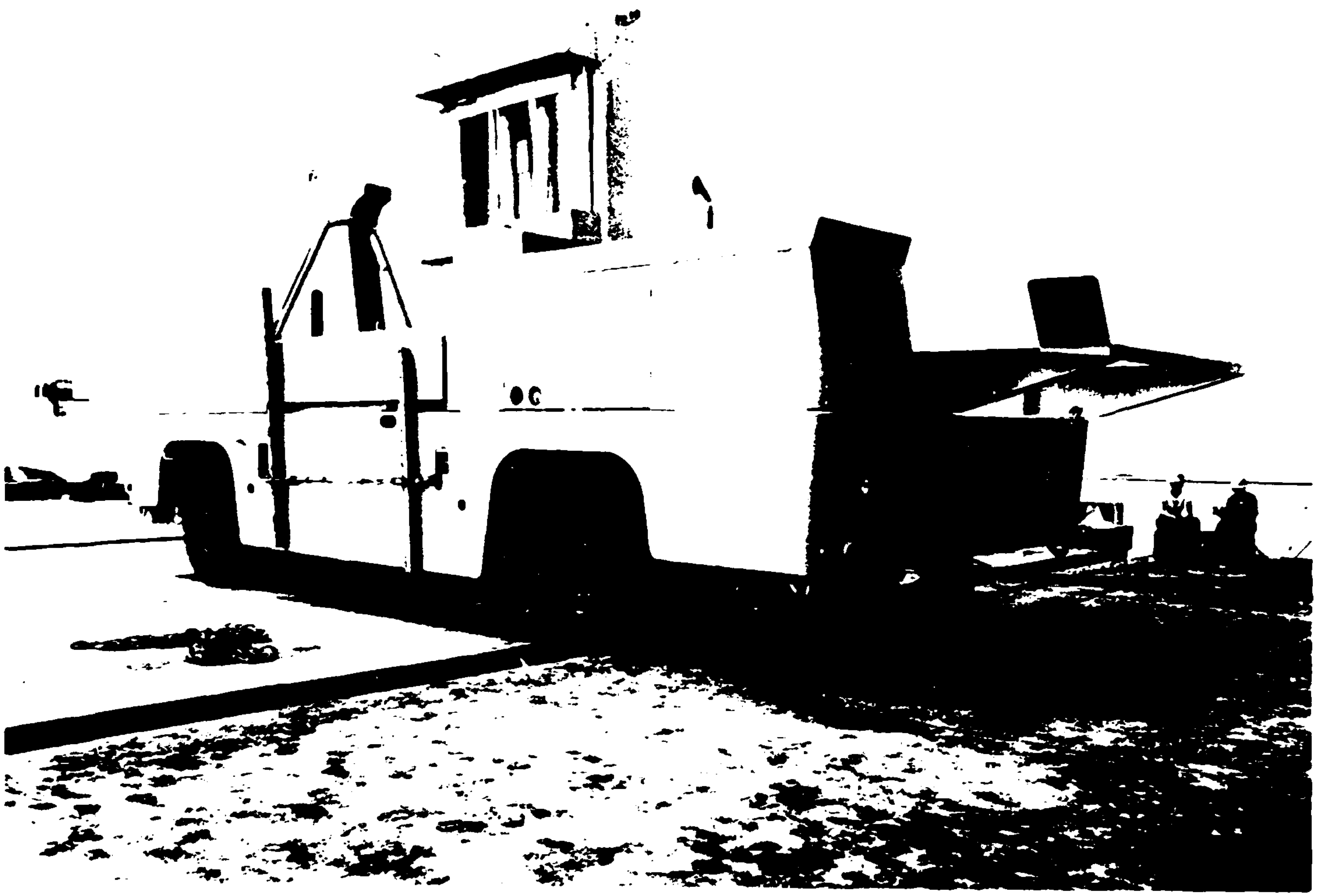
E.27. LCM8 WITH CARRIER UNDERWAY. Once the carrier had been off-loaded into the LCM8, it was necessary to start the carrier and back it approximately two feet up the well deck ramps to improve the trim of the LCM8 while underway. In the process of backing, the carrier got too far to the left side and the LCM8 took a slight port list.



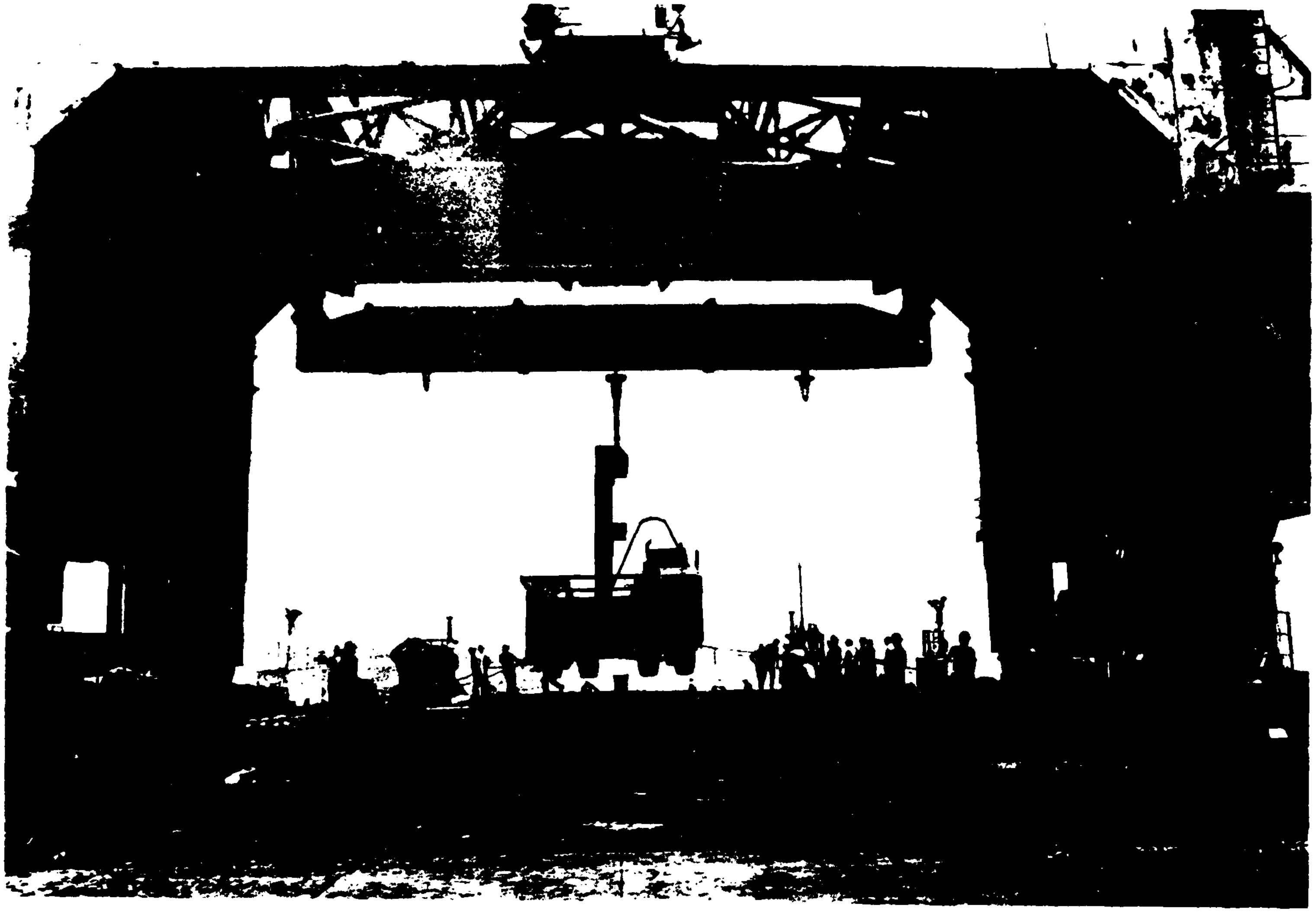
E.28. SIDELOADER READIED FOR HOISTING. Since sideloaders are also new and heavy items in the Army inventory (this one weights approximately 70 short tons), it was necessary to rig a special sling. Rigging required 51 minutes during the loading cycle plus 9 minutes to attach the load and [illegible] minutes to detach it from the LCM8 lift beam. Rigging during off-loading required about 4 minutes to prepare the lift beam and 4.5 minutes to attach and detach the sideloader.



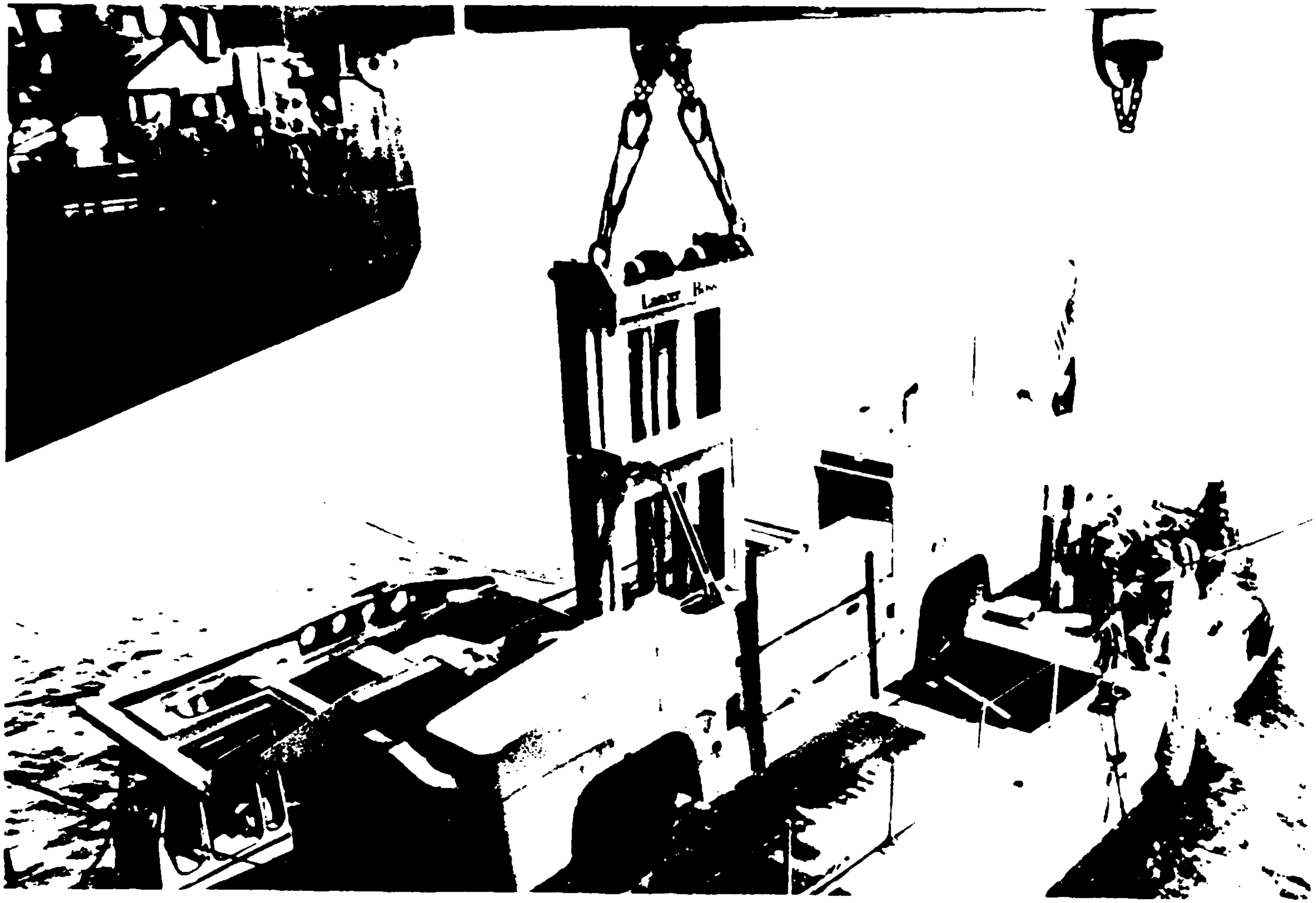
E.29a and E.29b. SIDELOADER LIFTED. The sideloader was hoisted by its mast which, in turn, was held in a centered position by planking specially cut and fitted as shown above.



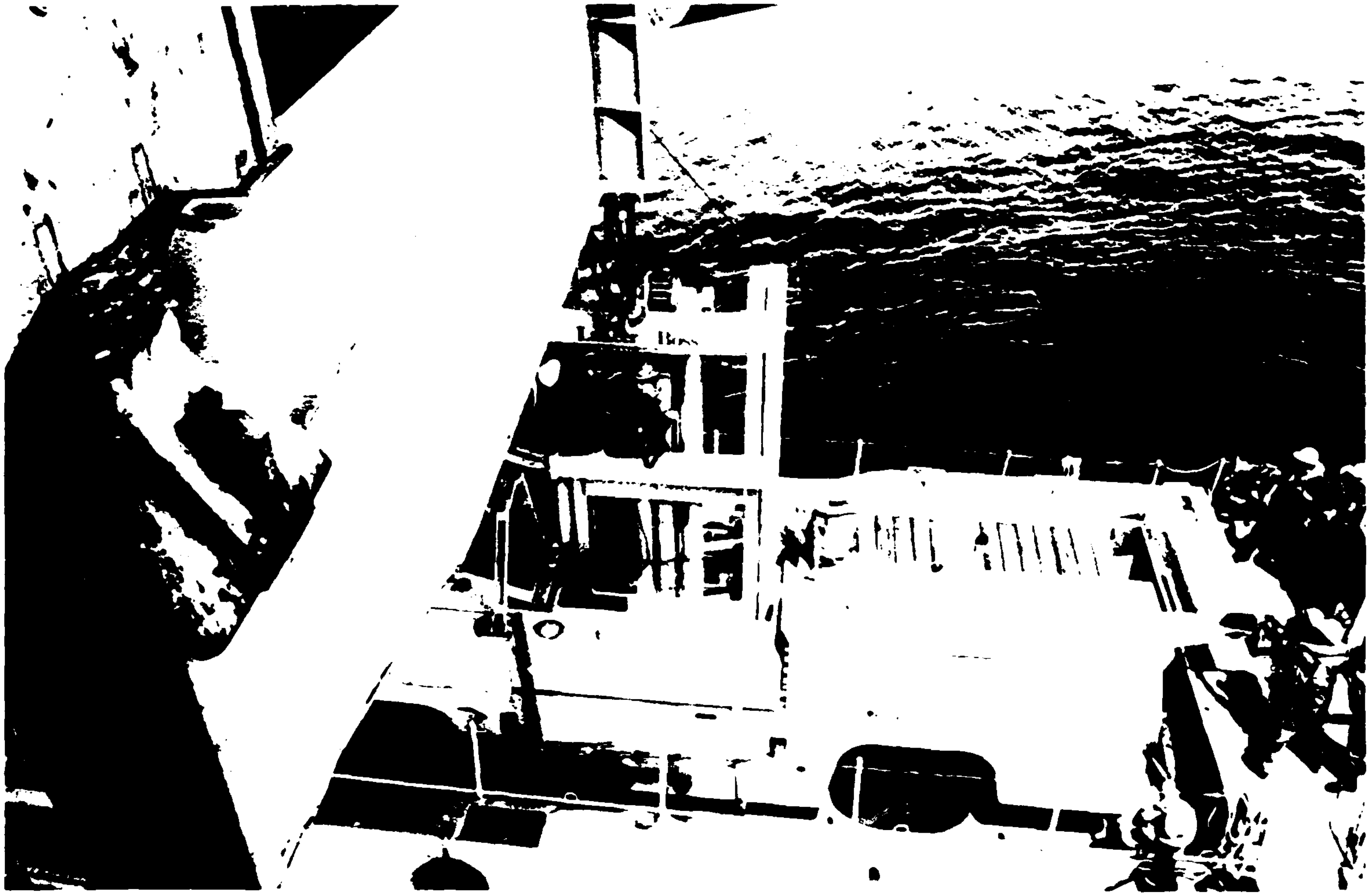
E.30. SIDELOADER REPOSITIONED ON DECK. During the off-loading phase the sideloader was driven to a position near the ship's centerline where rigging was being accomplished. The only disassembly of the sideloader for the pretest was the removal of the container spreader bar, which only slightly reduced the weight of the 70-short ton sideloader.



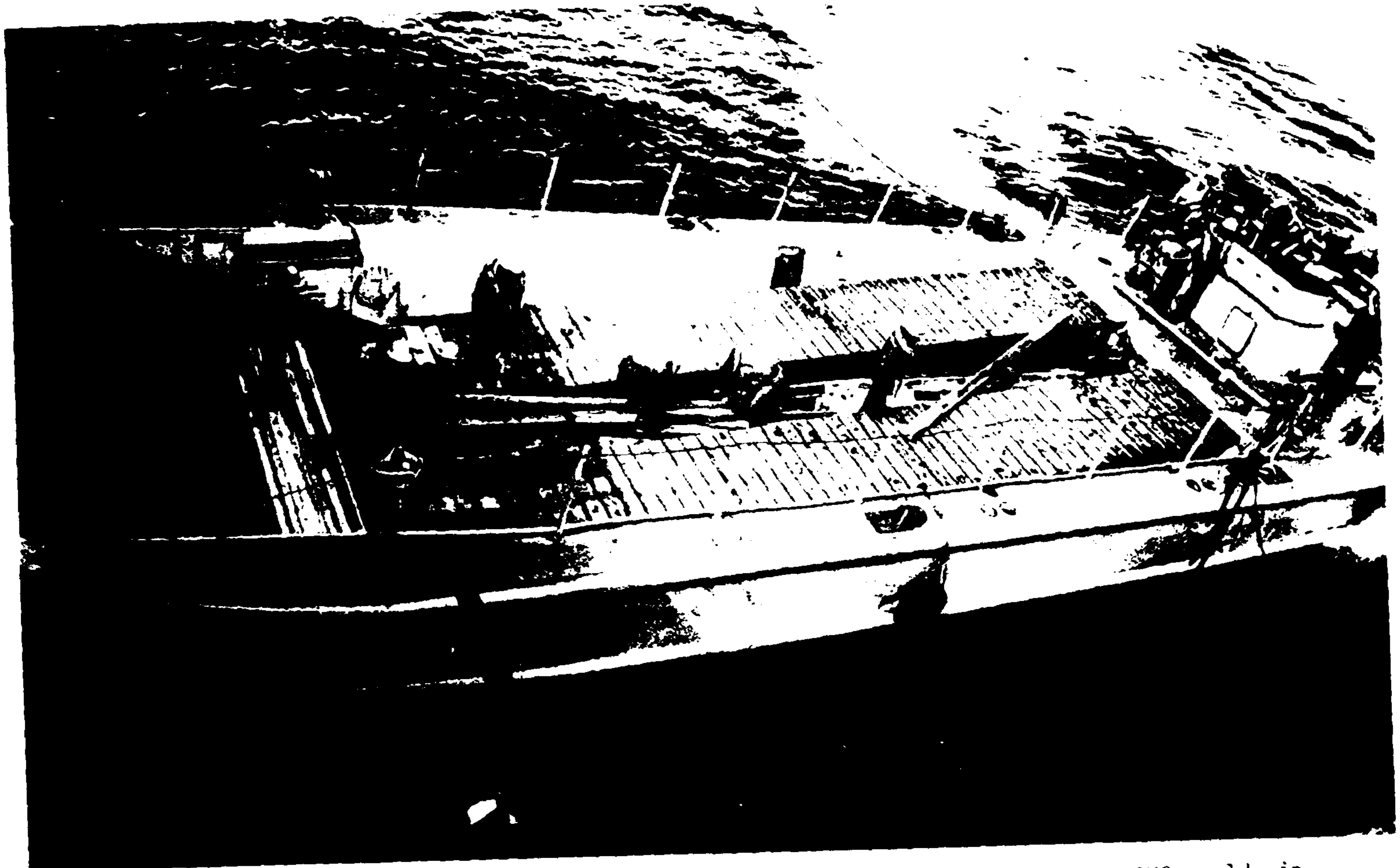
E.31. CRANE STARTS AFT. Once rigged, the 70-ton sideloader was easily lifted by the ship's gantry crane which has a 500-short ton lifting capacity.



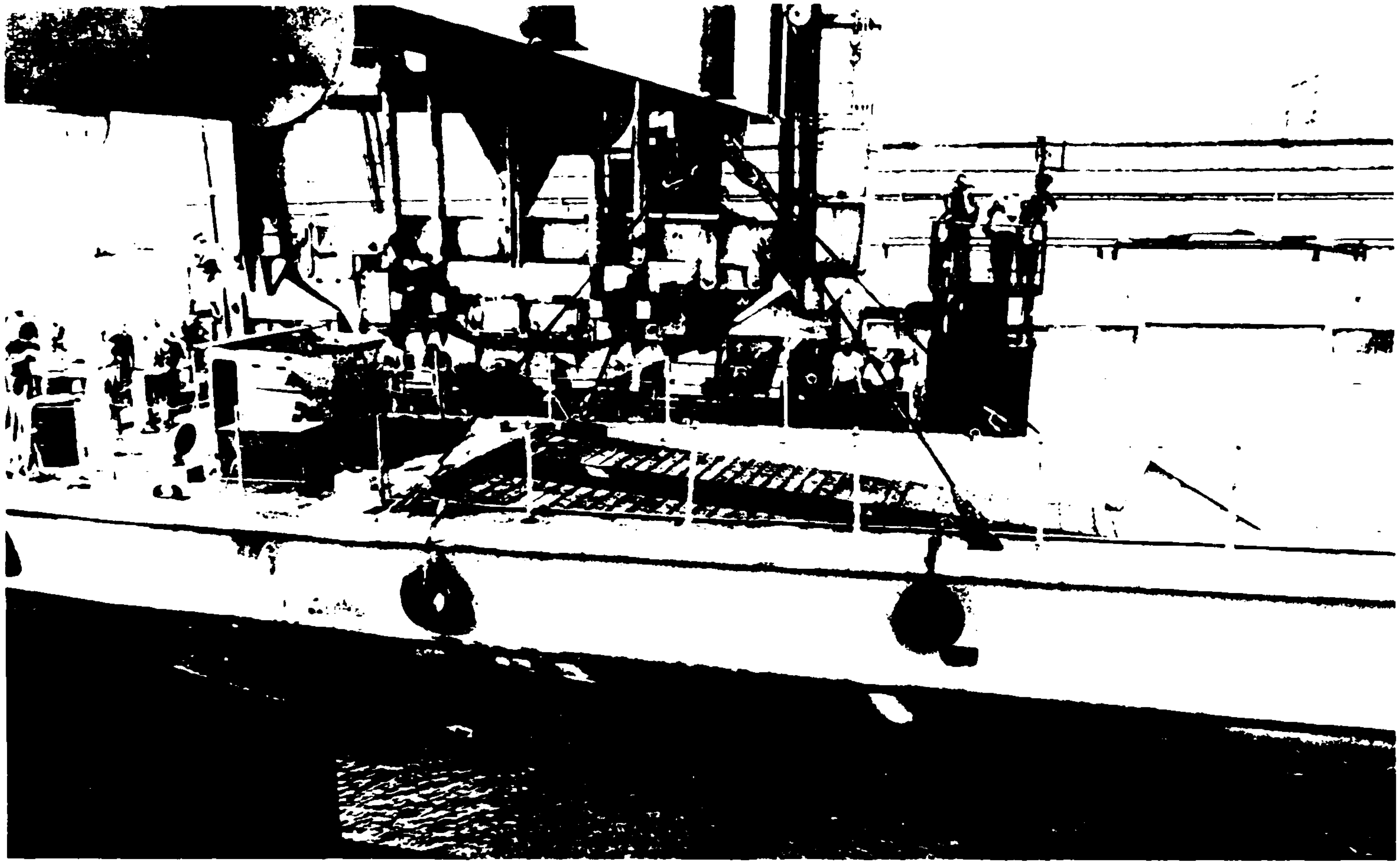
E.32. SIDELOADER IS LOWERED INTO AN LCM8. As with the other LOTS wheeled equipment, the sideloader was lowered into an LCM8. No difficulties were encountered in off-loading the vehicle. The total unloading time, including rigging, was 62 minutes.



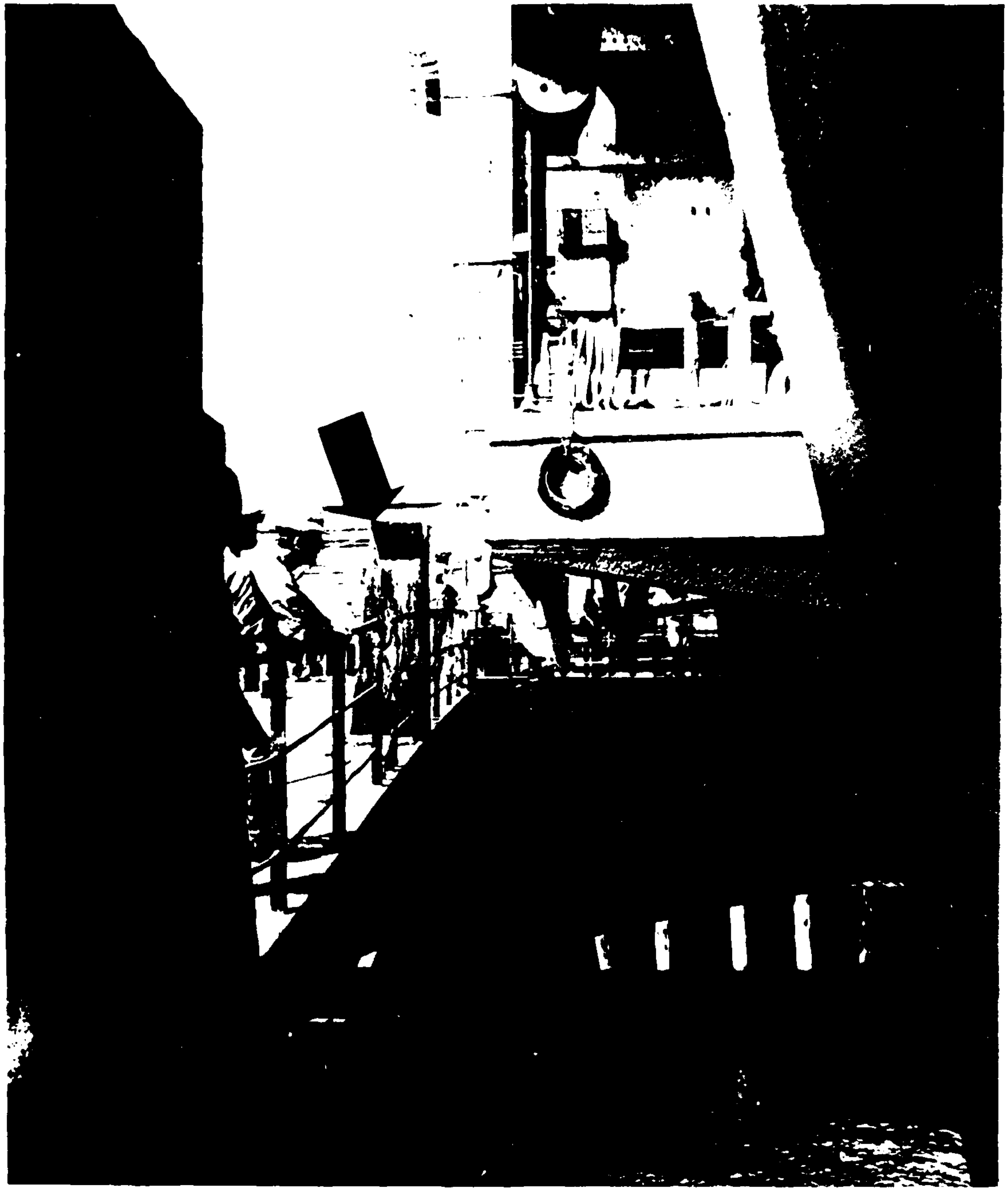
E.33. SIDELOADER DETACHED FROM LIFT BEAM. Once in the LCM8 the crew had to climb the sideloader's mast and unscrew the shackles. In a sea state having four-foot swells or greater, the procedure would be dangerous and could damage the sideloader and/or the LASH gantry crane. A longer sling and a faster method of unhooking are needed to alleviate this problem.



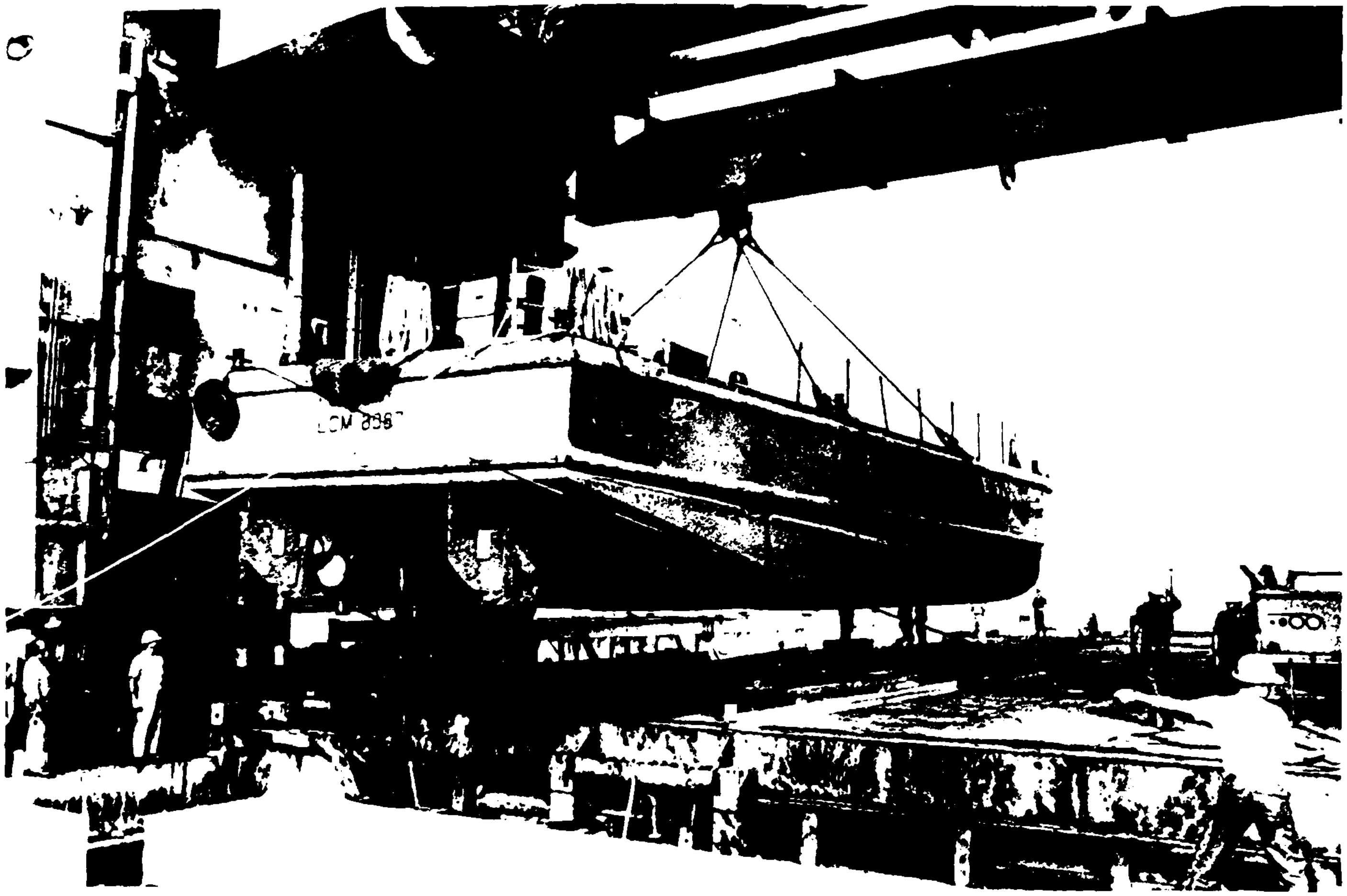
E.34. LCM8 READIED FOR HOISTING. One of the key pretest questions was whether an LCM8 could, in fact, be loaded aboard the LASH. Although the weight was not a factor (an LCM8 weighs 66 short tons, the one above weighed an estimated 76 short tons with the ramps), there had been sling and clearance problems in a 1974 test lift.



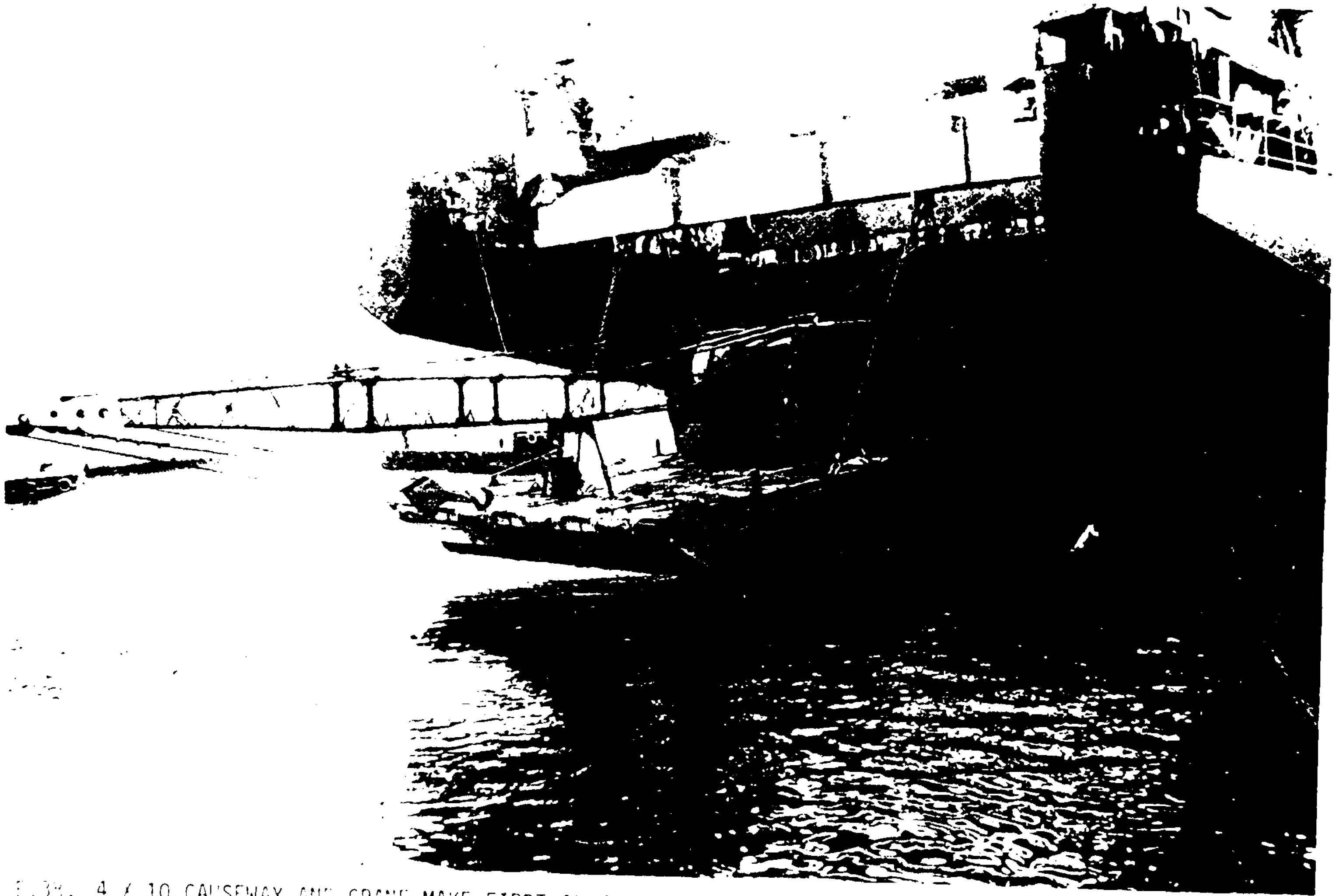
E.35. LCM8 SLING ATTACHMENT. The modified LCM8 sling shown above was used successfully. When the LCM8 was originally tested by Avondale Shipyard in November, 1974, an aluminum LCM8 (with different lifting points) and an unrecorded type of LCM8 lifting sling were used. In addition, the 130-ton shackles used could not be attached to the LCM8 sling directly and an additional pair of shackles had to be used. As a result, the LCM8 in that test lacked approximately two inches to clear the stern of the ship.



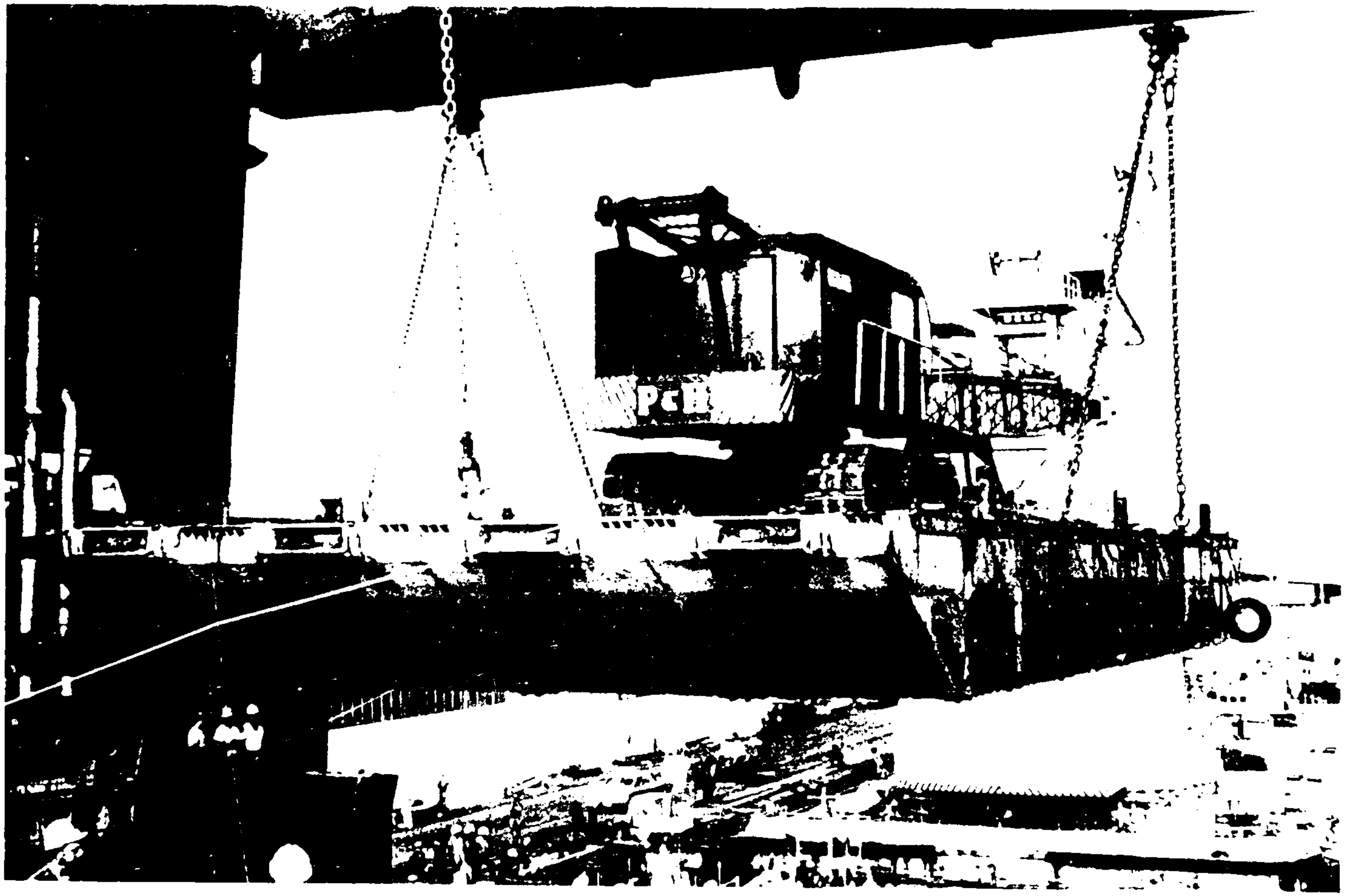
[illegible] M TRANSOM CLEARANCE ADEQUATE. In the LOTS pretest the LCM8 had [illegible]ately 12-14 inches between it and the ship's transom. In the Avondale [illegible] test the LCM8 failed to clear the dark pedestal, see arrow, to the [illegible] of the LCM8 stern. (In the above photo the LCM8 has not yet been lifted [illegible] crane's fully raised position. It subsequently cleared the [illegible].)



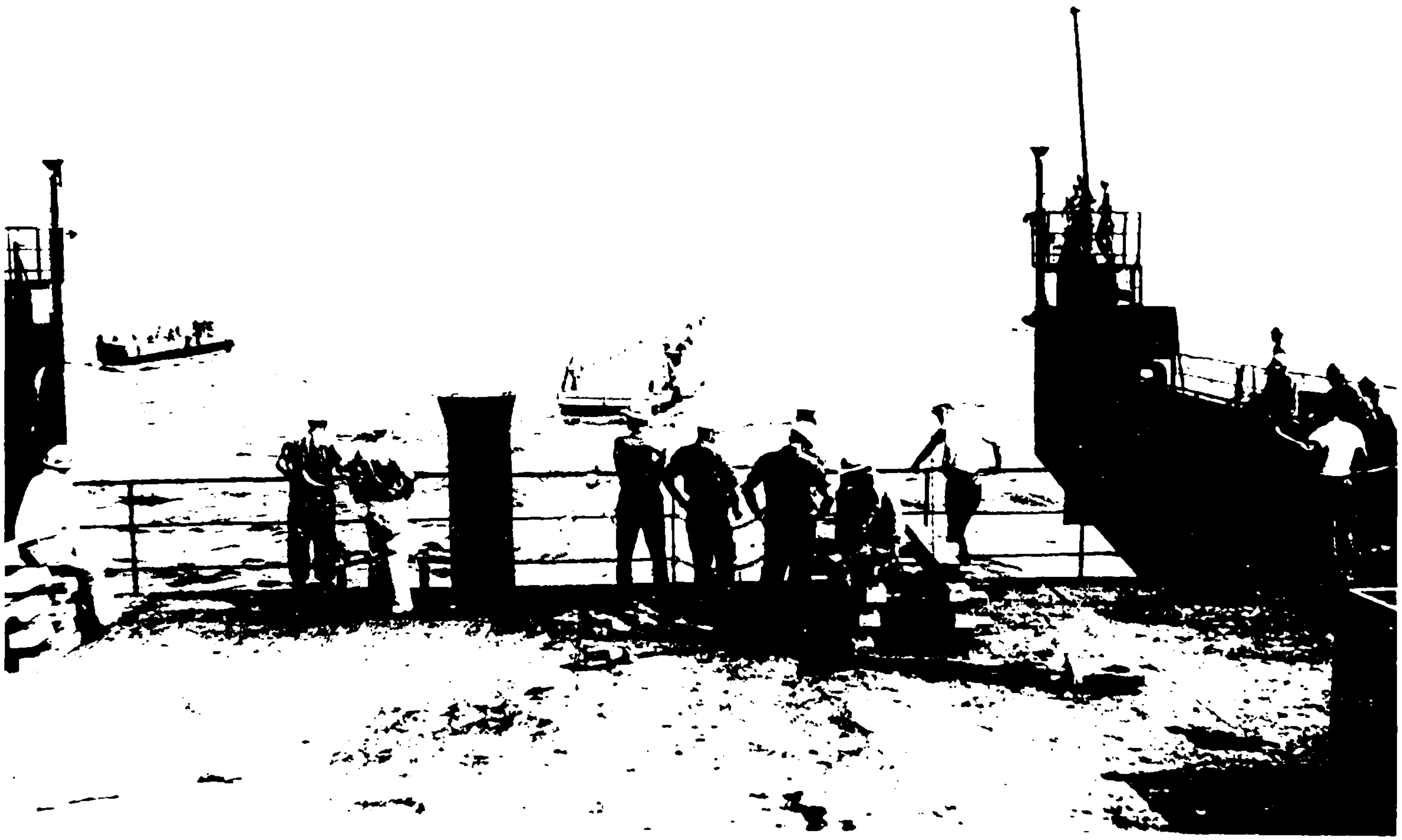
E.37. LCM8 IS LOWERED ONTO DUNNAGE. The LCM8 cleared the hatch squares by approximately $4\frac{1}{2}$ to 5 feet. The sling used for the LOTS pretest had legs which were shortened by approximately 12 inches to ensure clearance. A normal LCM8 sling would have sufficed. The cycle time, including all rigging, was two hours and 18 minutes for the loading phase and one hour and 16 minutes for the off-loading phase.



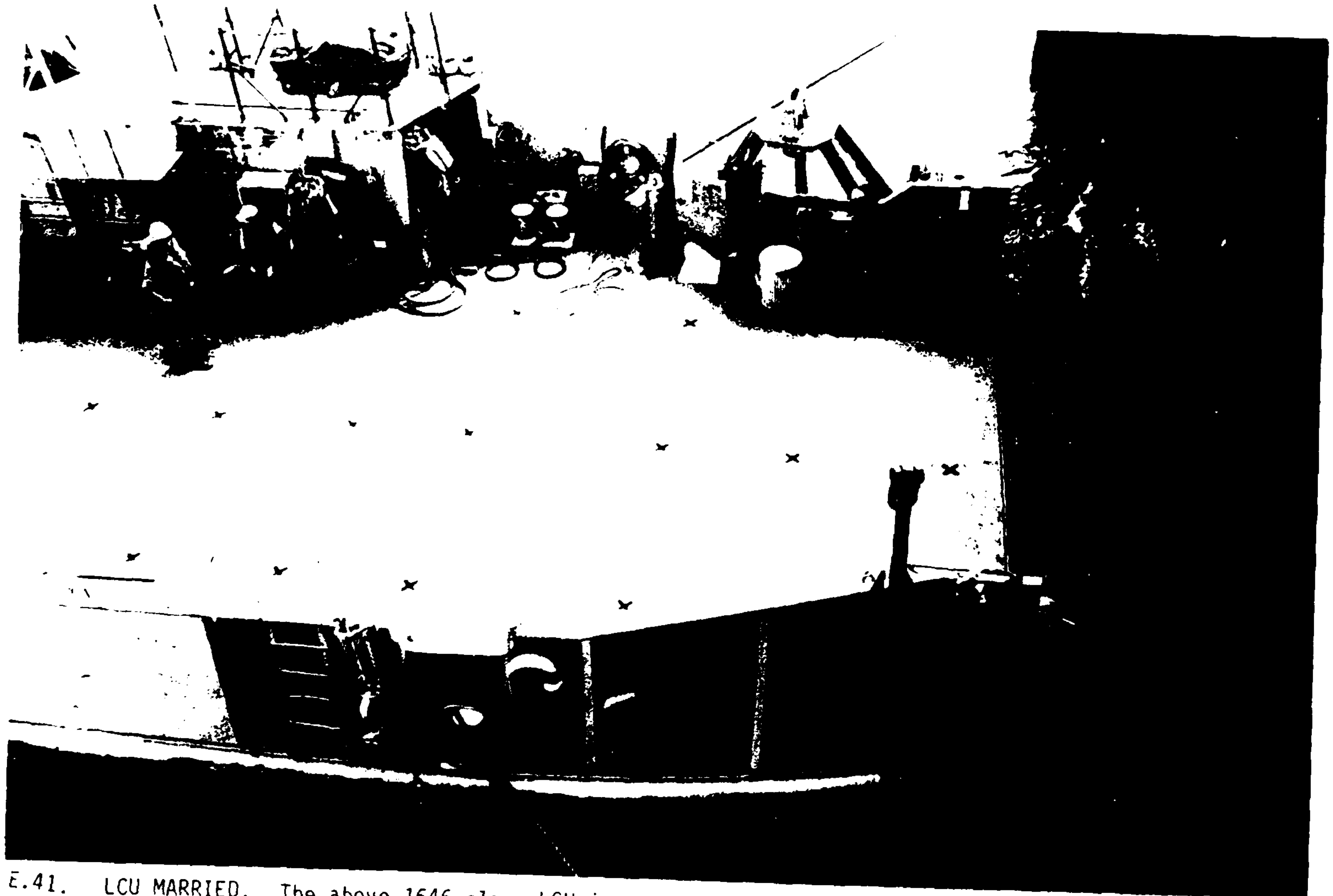
E.34. 4 x 10 CAUSEWAY AND CRANE MAKE FIRST ATTEMPT. A 4 x 10 section of causeway with a 30-ton capacity crane mounted on it was initially hoisted but subsequently had to be lowered to lengthen a chain off the forward lift beam. The lift was then made at a level attitude.



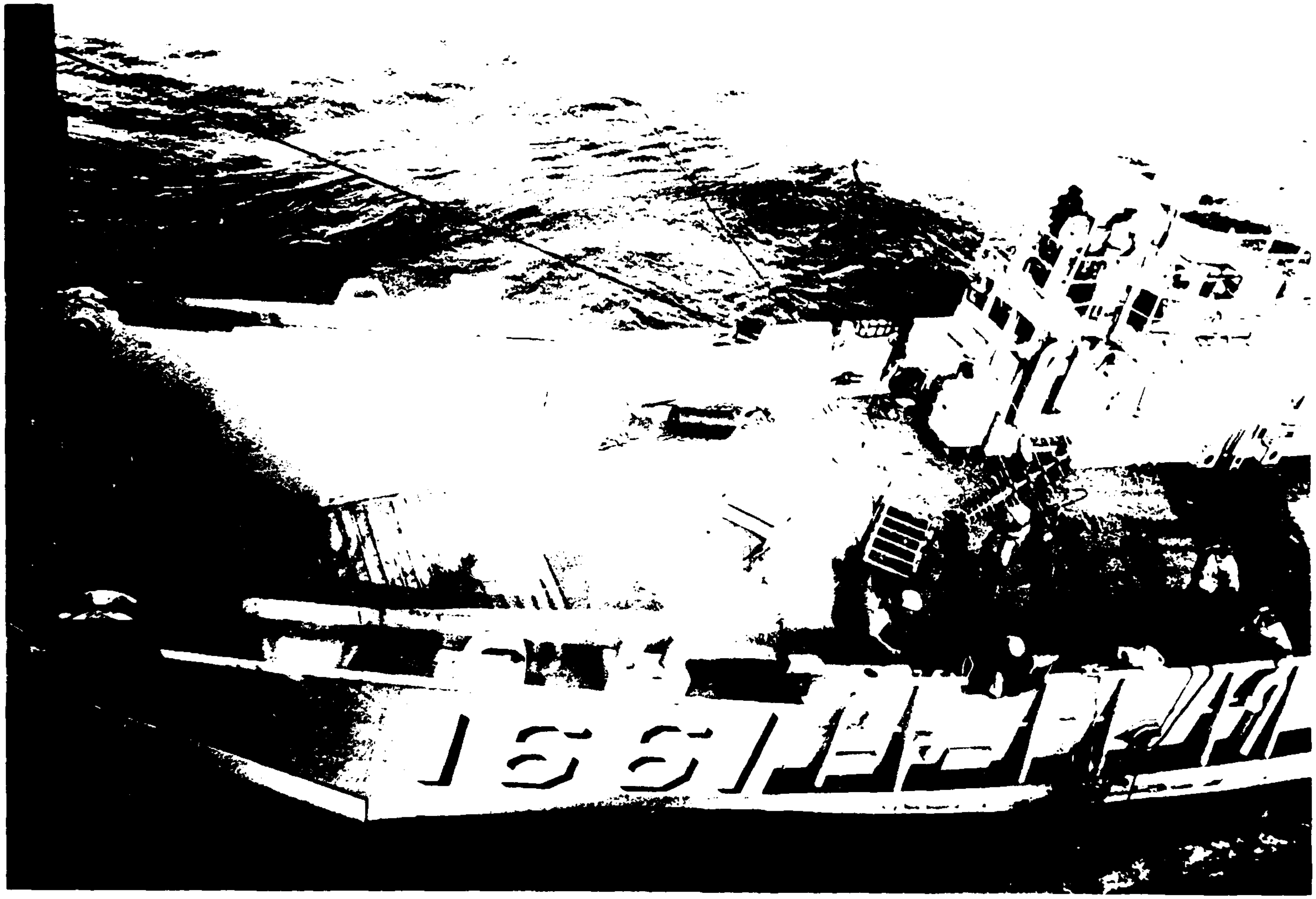
E-39. 4 X 10 CAUSEWAY AND CRANE USED ONLY CHAINS AND H[illegible]S. One of the major causes for delays was the considerable use of [illegible], shackles, and cables, which were slow in attachment and detachment from equipment. The chains and [illegible] used above were faster and, therefore, somewhat [illegible], particularly for use in the well area [illegible]



E.40. LCU MAKES APPROACH FOR MOORING. During the off-loading phase while the causeway lifting frame was being attached to the LCM8 lift beams, mooring approaches were made to the LASH ITALIA's stern. Above a Navy 1646-class LCU tries a stern gate approach.

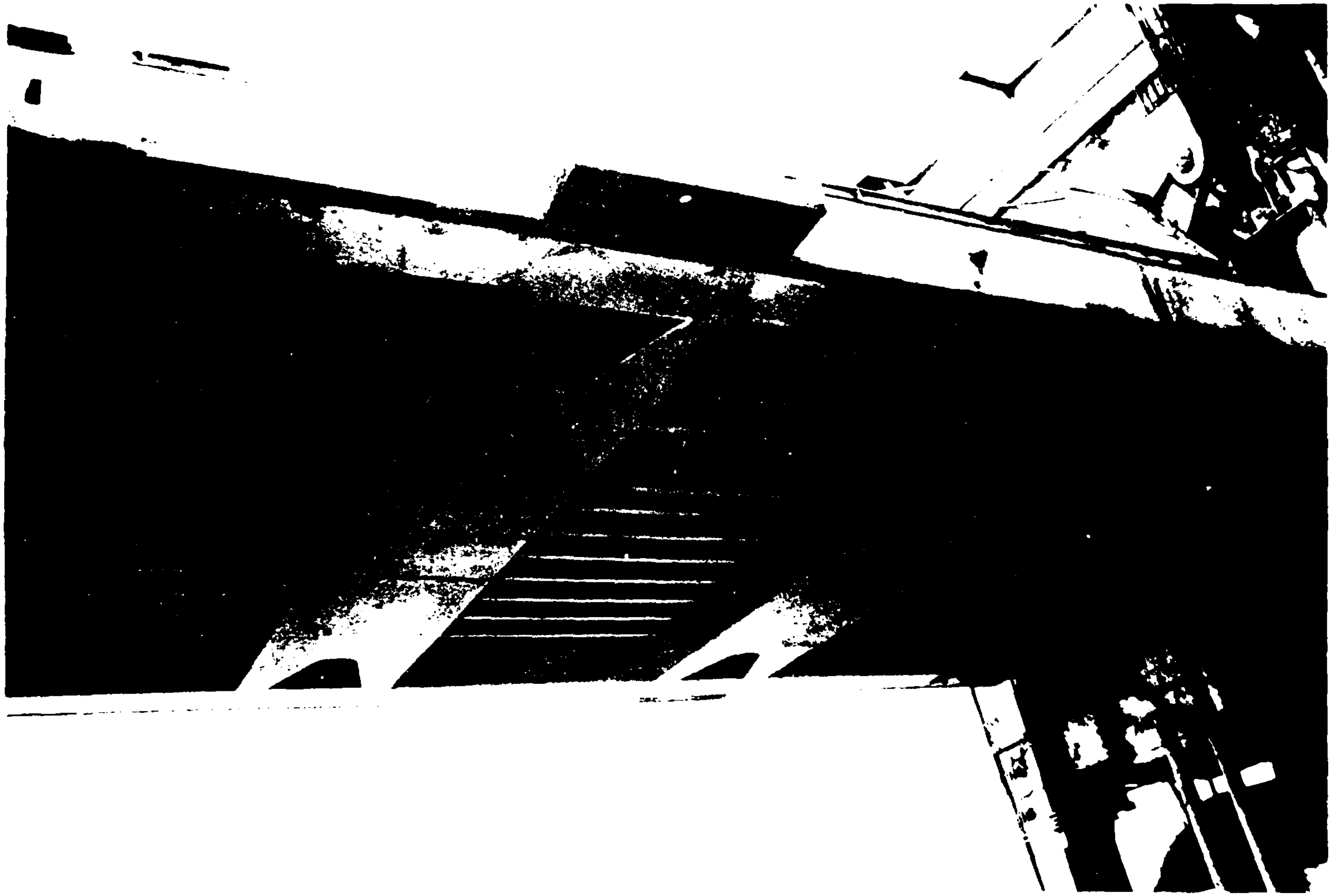


E.41. LCU MARRIED. The above 1646-class LCU in a stern-to-stern marriage with the LASH presented the best prospect for off-loading. Powered snubbing lines from the LASH stern helped position and hold the landing craft. The above marriage required eight minutes timed from when the LCU was approximately 250 yards off the stern.

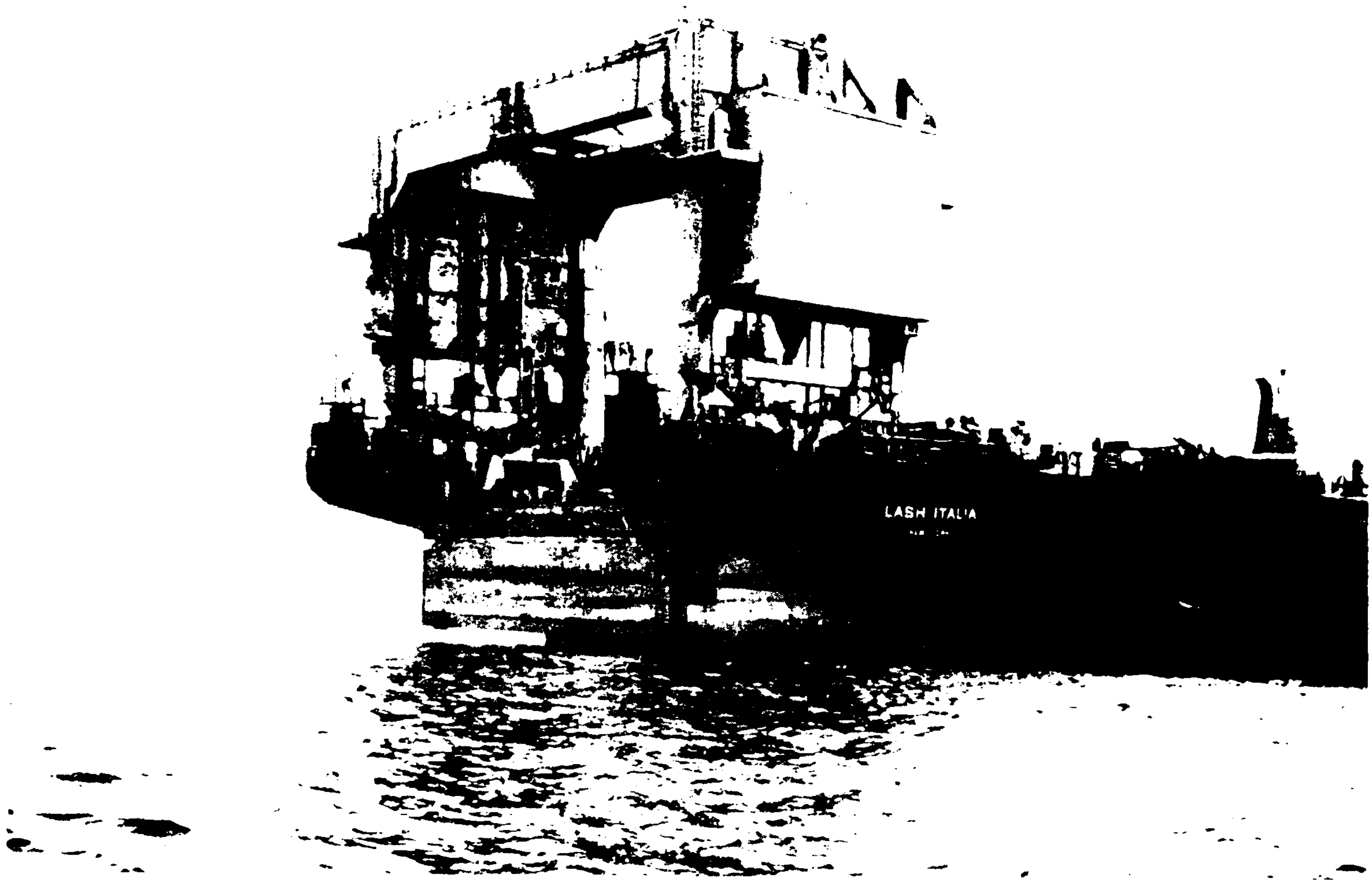


E.42. LCU RAMPS RESTRICT LOADING. The same Navy LCU also made a bow-on marriage. The high gunwales and ramps present a less desirable loading perspective than the stern approach.

E.43. CRANE ENGAGES HATCH COVER. Once the deck was cleared of test cargo the hatch cover to cell 3C was opened and the last phase of the LASH unloading operations was initiated. The cycle time for removing the hatch cover was 13¼ minutes.



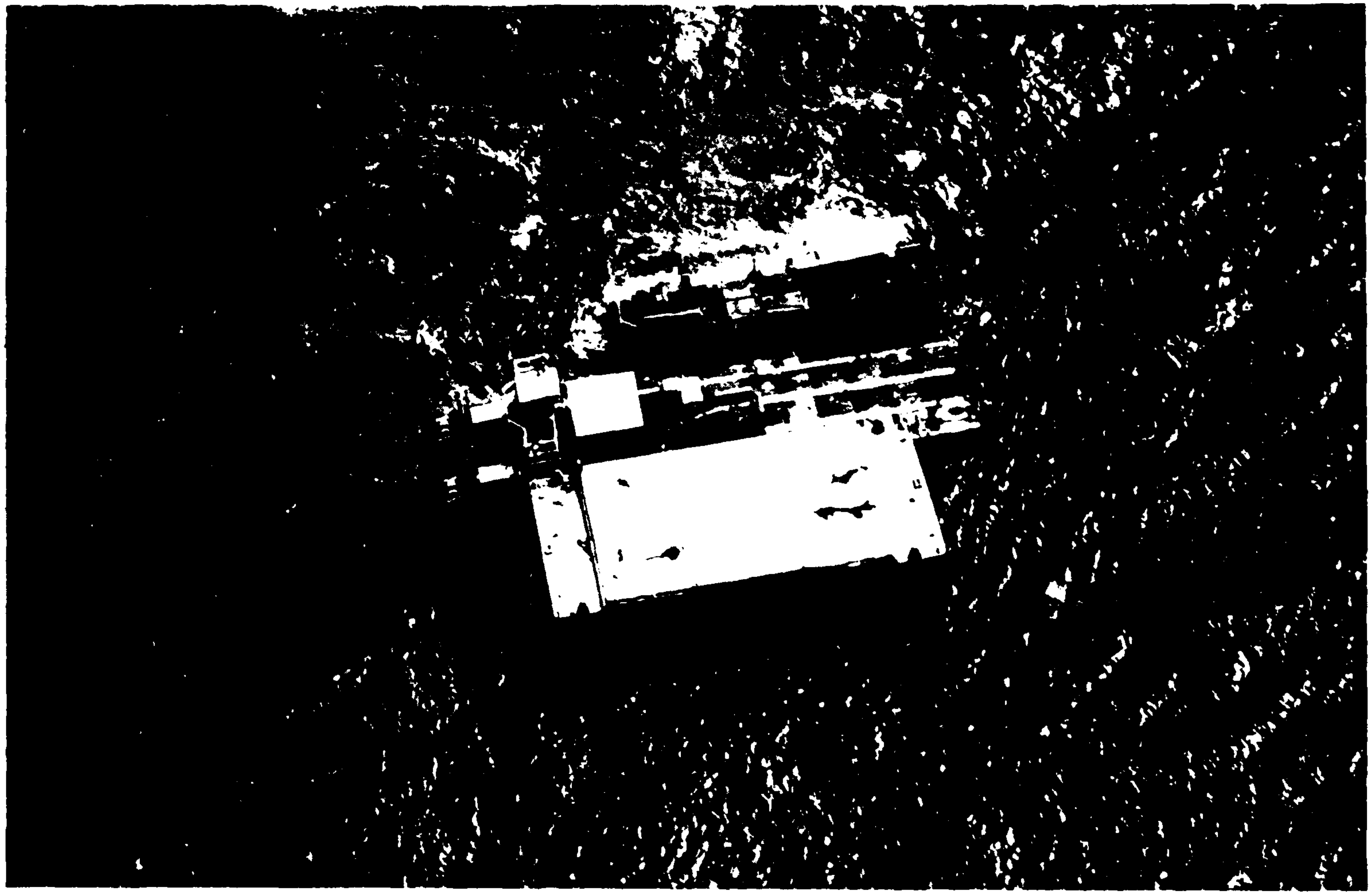
E.44. HATCH COVER REINFORCEMENT. As may be seen from the underside of a hatch cover (shown above), there was ample reinforcement to support the military equipment stowed on deck. [illegible] equipment was landed on deck and driven around when [illegible].



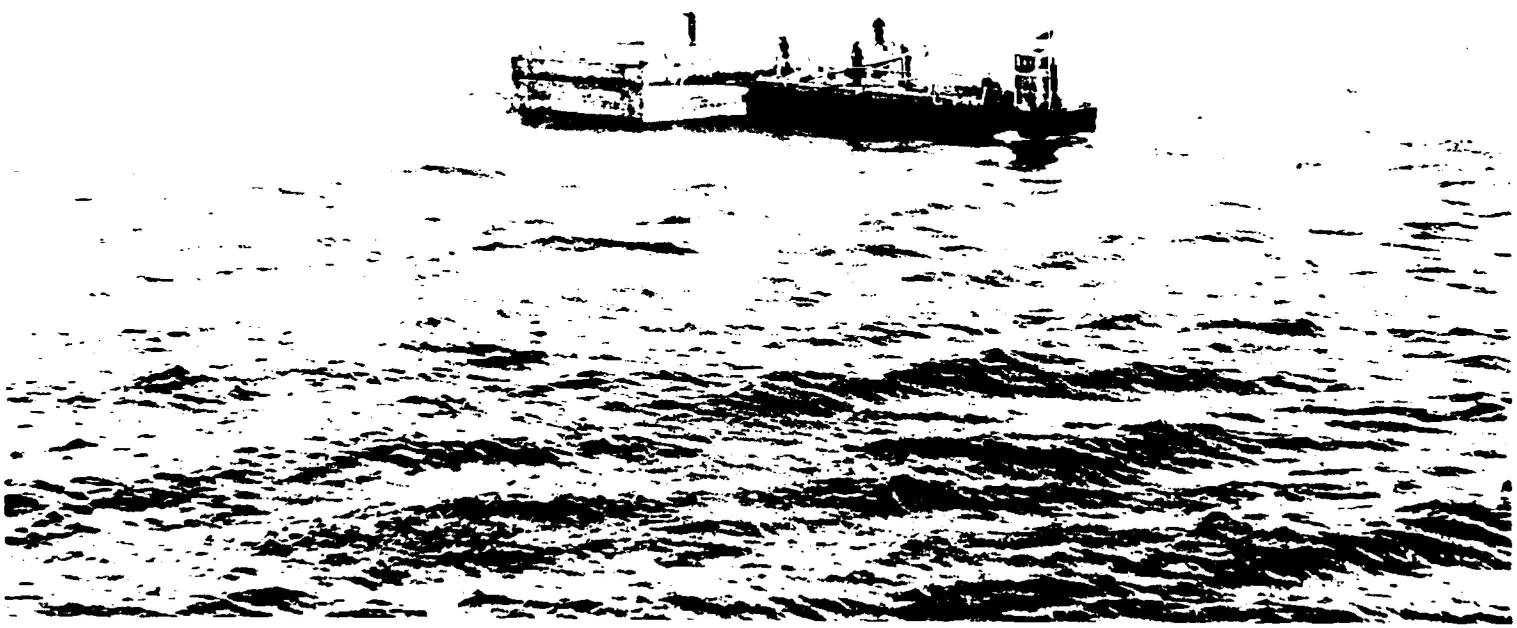
E.45. FIRST BARGE GOES INTO THE SEA. Above, the first of four barges is off-loaded. Unloading times for the barges, respectively, were [illegible], [illegible], [illegible], and [illegible] minutes.

[illegible] EMPTY CELL. Above is a view of cell 3C where the four LOTS pretest [illegible] had been stowed.

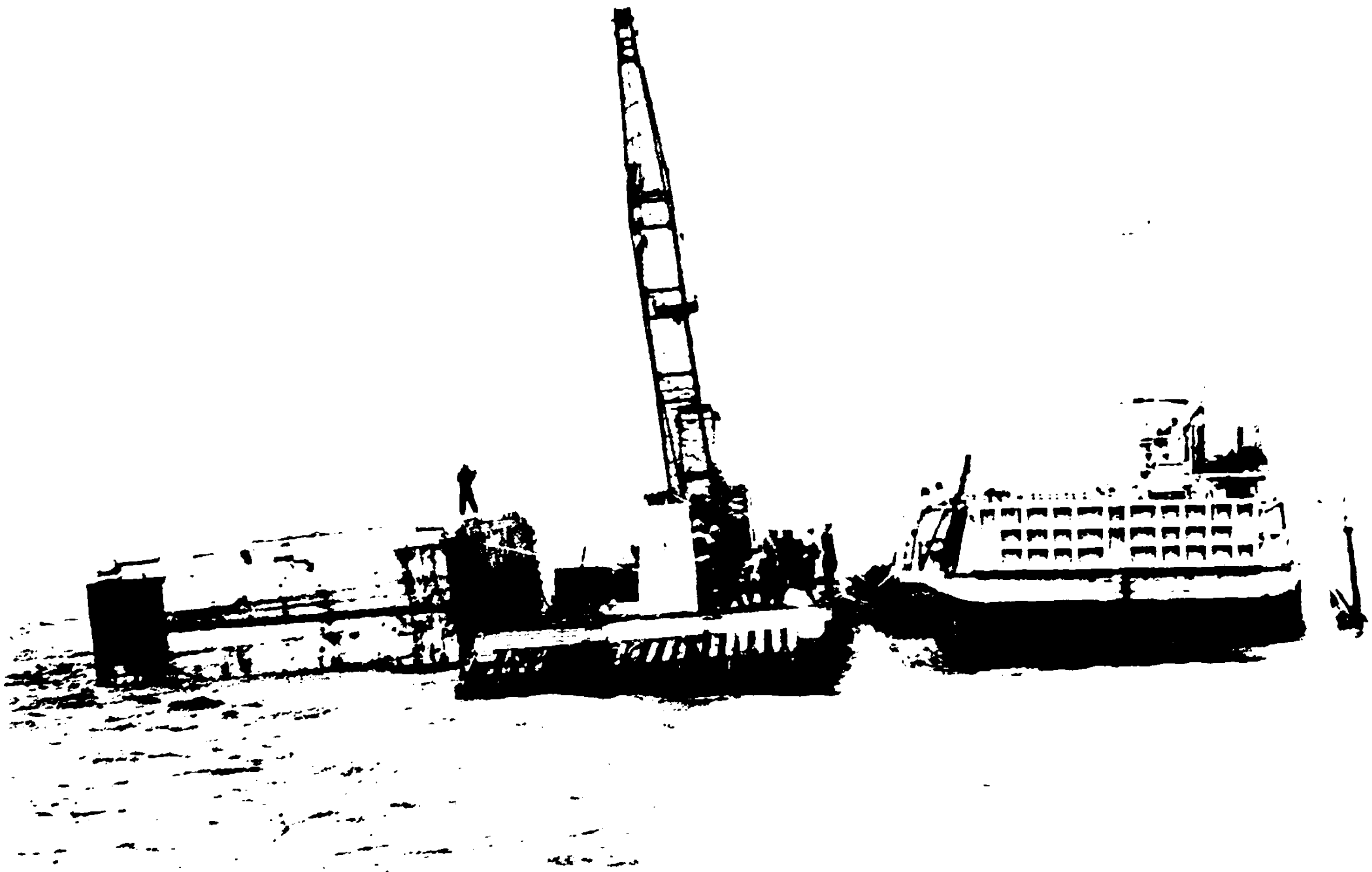
E.47. LCM6 TENDER BOAT CLEARS WELL. Navy LCM6 tender boats/warping tugs were used to clear the LASH barges from the well area. The tender boats had no difficulty towing the barges clear of the well, thereby permitting the barge gantry crane to operate without delays. Subsequently, some difficulty was experienced by one craft when winds and seas became worse.



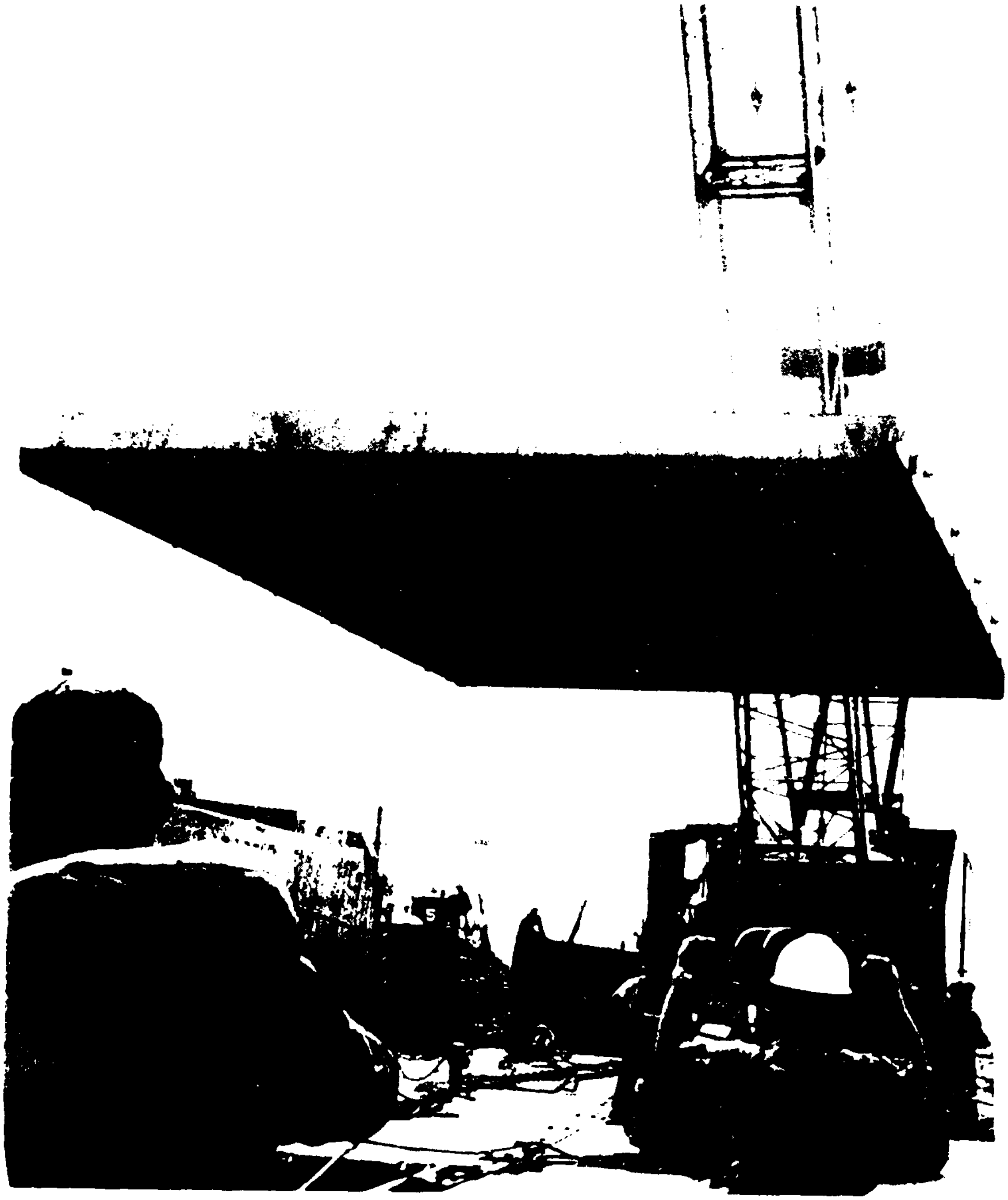
E.48. 3 X 14 CAUSEWAY WARPING TUG TAKES BARGE UNDER TOW. As the seaway conditions worsened an LCM6 tender boat needed assistance from a more powerful 3 x 14 causeway warping tug to moor the barge to a nearby buoy.



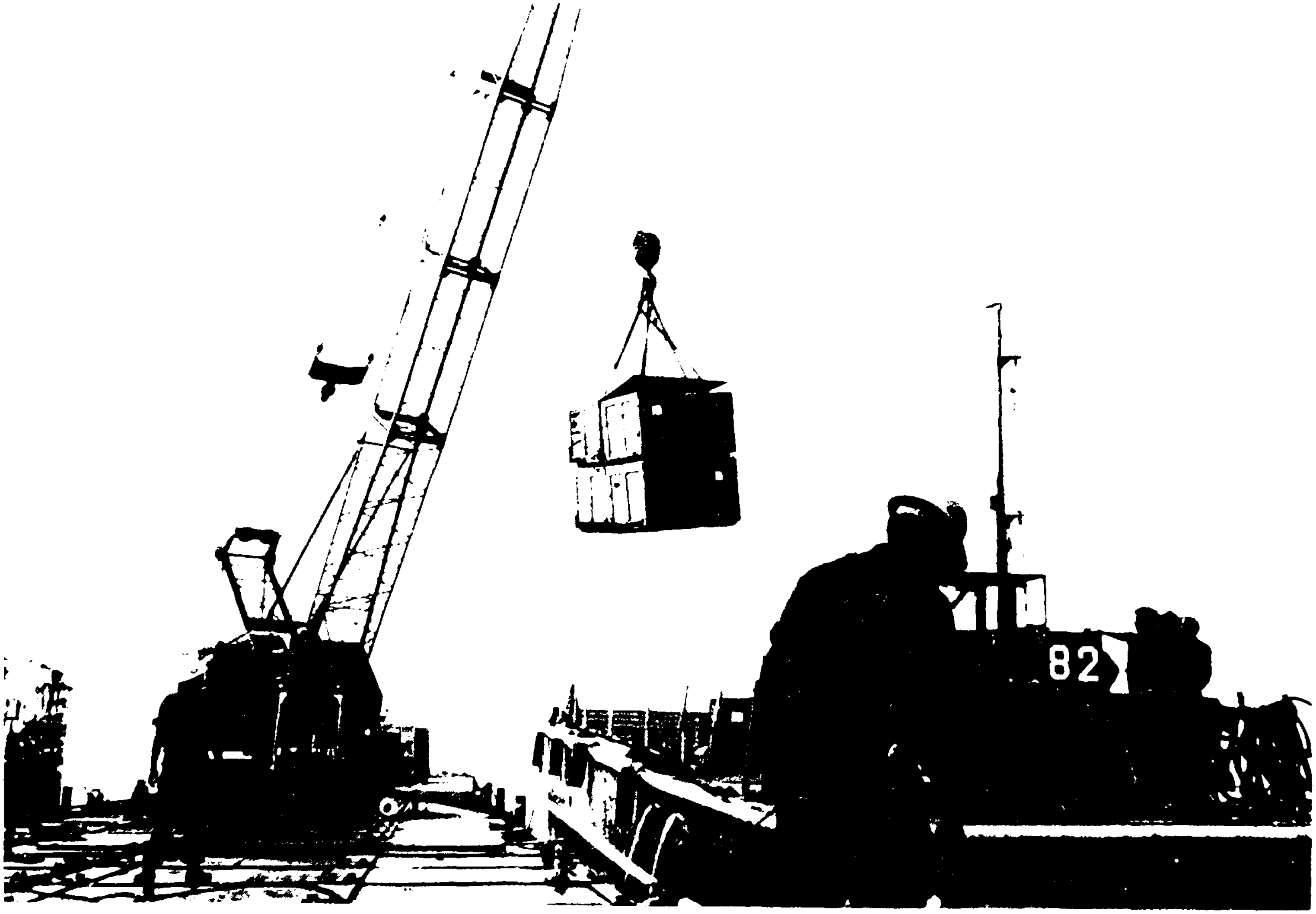
E.49. UNDERWAY. An LCM6 Warping Tug took one of the barges and successfully pushed it to the LASH barge mooring buoy. In another experiment two LCM6 tender boats also successfully took a barge under tow.



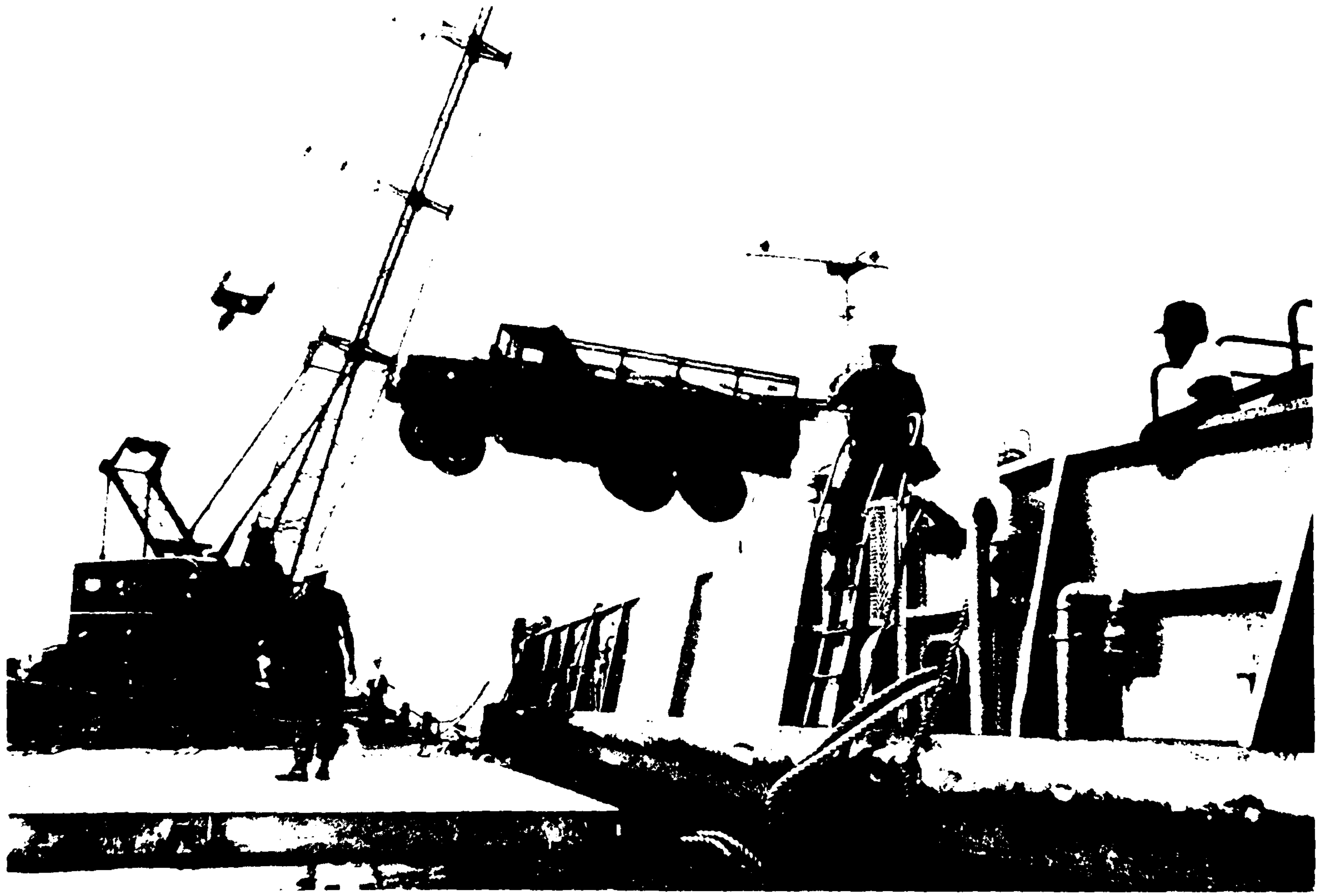
E.50. FLOATING CARGO TRANSFER PLATFORM. A floating cargo transfer platform was moored to a buoy approximately 800 yards off Green Beach. The platform was used in unloading cargo from LASH barges (at left), which could not be beached, into landing craft (at right). The platform basically consisted of a 4 x 10 causeway section with a 30-ton crane mounted on it and two 3 x 15 causeway sections, one attached to each end.



F.52. FORKLIFT LOADED. Once pallets had been unloaded from the open hatch square, it was necessary to use a forklift to reposition the remaining pallets for offloading.



E.53. MOST CARGO WAS PALLETIZED. During the 30 hours the floating cargo transfer platform was operating, approximately 350 pallets were off-loaded.

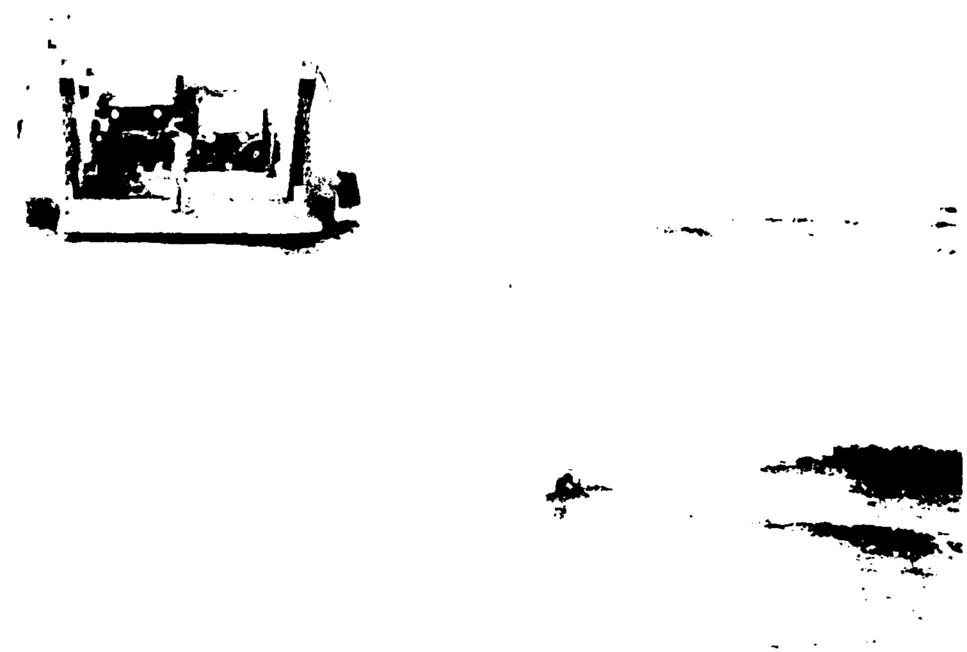


E.54. VEHICLES OFF-LOADED ALSO. Not only pallets were off-loaded from the [illegible] barges; one barge contained a number of vehicles. The largest vehicle off-loaded was an [illegible] truck (shown above), weighing approximately seven short tons plus the weight of some [illegible] loaded in its cargo bed.

[illegible] WOMEN STEVEDORES EMPLOYED. The Navy is currently conducting a study [illegible] women in non-traditional roles within the service. During the [illegible] test [illegible] women were employed in the same roles as men. Besides standing [illegible] as shown above, the women were also used in more physically taxing roles [illegible] handling taglines, driving forklifts, and [illegible] lifts.

E.56. LCM8 OFF-LOADED. Once landing craft had been loaded at the floating cargo transfer point, they proceeded to Red Beach where they were unloaded. The above LCM made its approach at high tide and had a relatively "dry" ramp because the beach is steep near the high tide mark.

E.57. NEARBY CAUSEWAY USED. The LCU previously shown is seen retracting from Red Beach (at right). It discharged its load of vehicles across a floating causeway that had been erected by Reservists in a separate exercise at Blue Beach, shown on the left.



E.58. LOW TIDE CAUSED BEACHING PROBLEMS. The gentle beach slope usually resulted in wet ramps, particularly for LCUs. The above Navy LCU was unable to clear an off-shore sandbar and had to retract.